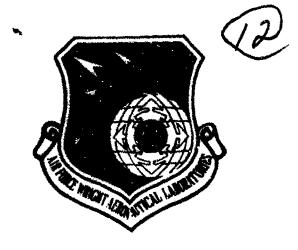
AFWAL-TR-81-4172

DEVELOPMENT OF ENGINEERING DATA ON ADVANCED COMPOSITE MATERIALS



University of Dayton Research Institute University of Dayton Dayton, Ohio 45469

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Final Report for Period 1 September 1978 - 30 September 1981

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MATERIALS LABORATORY AIR FORCE WRIGHT AERONAUTICAL LABORATORIES AIR FORCE SYSTEMS COMMAND WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433

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Environmental Aging

Epoxy
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20. Abstract (Concluded)

finterlaminar shear) were measured on various fiber orientations at four different temperatures (-67°F, 72°F, and two elevated temperatures). Tensile fatigue, creep, and stress-rupture tests were also conducted and four thermophysical properties (thermal expansion, thermal conductivity, specific heat, and glass transition temperature) were determined. Environmental agings (at 160°F and 100 percent relative humidity) were conducted on each material and the effects on this exposure on several mechanical properties were determined. On four of the materials, tests were conducted on specimens with a hole located in the center of the gage section. On the last material, three different ply stacking sequences incorporating 0°, 90°, and 745° plies were tested. These three different sequences gave rise to tensile; compressive, and zero stress in the thickness direction at the specimen free edges.

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PREFACE

This summary report covers work performed during the period from 1 September 1978 to 30 September 1981 under Air Force Contract F33615-78-C-5172. The contract was initiated under Project Number 7381, "Materials Application". The work was administered under the direction of the Systems Support Division of the Air Force Wright Aeronautical Laboratories/Materials Laboratory, Wright-Patterson Air Force Base, Ohio. Mr. David Watson (AFWAL/MLSA) acted as Project Engineer.

This work was conducted under the general supervision of Mr. D. Gerdeman, Project Supervisor. The Principal Investigator for this program was D. Robert Askins. Research Technicians who made major contributions to the program include:
R. J. Kuhbander, D. Byrge, R. Glett, R. Rondeau, D. Pike, D. Miller, and W. Miller.

The author is also indebted to Dr. Fred Bogner for the analysis and computation of normal edge stresses in the multi-directional laminates.

This report was submitted by the author in October 1981. The contractor's report number is UDR-TR-81-85.

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SECTION 1 INTRODUCTION

Fiber reinforced composite materials have been used in Aerospace structures for many years. The use of these materials is continually growing, and as new fiber reinforcements and matrix materials become available, the problem of selecting materials becomes an ever-growing task for aircraft builders and designers. In order to screen and select materials for a particular aircraft structure, a certain minimal amount of engineering data must be available to the aircraft designer. The data base from which this information is extracted must be continually updated and supplemented so that the spectrum of available candidate composite systems for consideration be broadened in step with the latest technological advancements. Data such as this are intended to reduce the time lag between the development of a new composite material system or component and its eventual use in an aircraft system. The general objective of this program was to develop engineering data on advanced composite materials. These materials were to be newly developed composite materials systems which were commercially available, but which at the same time were new enough that little data was available for the purpose of evaluating their potential. The purpose was to generate physical, mechanical, and thermophysical properties on a number of these advanced composite materials. The data generated in this program are not sufficient to eliminate the need for more detailed and more comprehensive design data programs. Rather, an initial data base is developed to facilitate the selection of candidate materials, and which provides a basis for developing subsequent design allowable efforts on selected materials. It provides the information required to make preliminary assessments of composite materials for potential aerospace service.

SECTION 2 SELECTION OF MATERIALS

The initial portion of the program involved an identification of available candidate composite materials. Both written and verbal contact was established with a wide cross-section of industry and government representatives who are active in the area of composite materials research, development, and application. Letter questionnaires were sent to individuals representing all the services, all the major aircraft companies, and nearly all of the major material suppliers. The questionnaire was directed toward obtaining each individual's feelings as to what materials should be considered for inclusion in this program, what their assessment of the current data availability on the various materials was, and their feelings as to potential applications for which the various advanced and newly available composite material systems might be considered. In addition, these representatives were asked what they felt the most useful and most needed type of engineering data were, as well as their feeling about the effect of manufacturing processes required for a specific composite material or its potential usage by the Aerospace community. These letter-questionnaires were sent to a total of 111 individuals. A total of 16 written responses were received, representing 14 percent of the total mailing. In addition to the written inputs numerous telephone contacts were made with individuals who did not respond in writing to our questionnaires and to obtain additional information to that requested in the letter. All the verbal as well as written inputs to this phase of the program were tabulated and discussed with Air Force Wright Aeronautical Laboratory/Materials Laboratory (AFWAL/ML) representatives prior to the establishment of a list of tentative candidate materials for possible inclusion in the program.

The criteria employed to determine and select these candidate materials included (a) the present or imminent commercial

availability of the material, (b) the degree of interest in the material expressed in the written responses and telephone contacts, (c) the material's potential to overcome specific problems of current concern to the United States Air Force (USAF), and (d) the potential value to the USAF if the material proves applicable to Air Force weapons systems. The candidate material identification and selection process was a continuing activity throughout the program. As new materials were learned of they were added to the candidate list and telephone inquiries were initiated to learn as much as possible about the material. A total of six composite systems were ultimately selected from among the candidates for inclusion in the data generation effort. These six selections were made approximately every six months starting at the beginning of the program. Table 1 lists the candidates which were considered at one time or In most cases a fiber or resin matrix candidate another. is listed alone.

The six composite material systems ultimately selected were:

- (1) T300/AFR800 by Hexcel,
- (2) SiC/5506 by AVCO,
- (3) HyE 2034D by Fiberite,
- (4) T300/V378A by U.S. Polymeric,
- (5) HyE 1076J by Fiberite, and
- (6) 6535-1 by AVCO.

The T300/AFR800 system was selected because it is an epoxy system which does not require refrigerated storage. It was developed by the Aerotherm Division of Accurex Corporation under contract to the Air Force Materials Laboratory to compete with 350°F (177°C) epoxy systems.

The silicon carbide/5506 system was selected because of the silicon carbide fiber. This fiber, on a carbon substrate, was developed by the AVCO Corporation and provides properties essentially equivalent to boron fiber but has a potentially

TABLE 1 CANDIDATE MATERIALS

	Material	Comments
1.	PKXA	A silane terminated polysulfone. This feature permits some end group cross- linking which improves solvent/moisture resistance and temperature capability.
2.	нуЕ 1076Е	A graphite/epoxy system alleged to be more moisture resistant than Narmco's 5208. Also supposed to be a higher elongation matrix than other 350°F (177°C) class epoxies.
3.	HMF-351/76	Same as #2 except a woven fabric.
4.	CPI-2272	A polyimide resin alleged to have equivalent or better moisture resistance and temperature capability than F178.
5.	NCNS	Developed to replace the M4-720 base resin used in 350°F (177°C) class epoxies. It is fire retardant, generates little smoke, and is water resistant.
6.	PMR-II	Second generation material claimed to have higher temperature capability than FMR-15.
7.	Х904В	A non-proprietary 350°F (177°C) epoxy system developed under USAF contract. Reputed to have low moisture absorption.
8.	E788	An elastomer modified epoxy system.
9.	LARC 160	A 550°F (288°C) polyimide supposed to have better handling and processing characteristics than PMR-15.
10.	AS/3006	A graphite/polyphenylsulfone (Radel PPS) system which processes easily and has good water resistance. Main short-coming is solvent resistance leading to stress-cracking.
11.	DAPI	Diaminophenylindane. A thermoplastic with 500°F (260°C) service capabilities and which processes easily. Its so resistance is principal problem.

TABLE 1 (Continued) CANDIDATE MATERIALS

	Material	Comments
12.	Pitch-based graphite fiber	Three grades are being developed, having nominal modulii of 55 msi, 75 msi, and 100 msi. This fiber is potentially very inexpensive.
13.	Glass matrix composites	High temperature capability. Excellent dimensional stability. Water and solvent resistant. Not yet commercially available.
14.	FP alumina fibers	Potential for low cost makes it a candidate to replace boron.
15.	SiC/epoxy	Silicon carbide on a carbon sub- strate has properties equivalent to boron but has a much lower cost potential.
16.	Phthalocyanine	A new matrix system being developed. It is alleged to have high toughness and good elevated temperature capabilities.
17.	V378A	A polyimide system with improved wet high-temperature properties. Microcracking is supposed to be substantially reduced.
18.	Thermid 600	Acetylene terminated polyimide system with 550-600°F (288-316°C) service capabilities.
19.	XPL 1056	This vinyl polyester resin system cures very rapidly at relatively low temperatures and pressures. Preliminary tests indicated very good moisture resistance. The material also appears to form a better bond to aramid fibers than epoxy resins, leading to higher shear and compression properties.
20.	High filament end graphite tow	Larger graphite tows now being developed reduce prepreg preparation costs.

TABLE 1 (Concluded) CANDIDATE MATERIALS

	Material	Comments
21.	AFR800	An epoxy resin system developed under Air Force contract which has a long room temperature shelf life.
22.	NR150B2	Probably the highest service temperature organic matrix system available. Very difficult to process.
23.	RX-6450	N-cyanosulfonamide. An addition type resin that cures like conventional epoxies but offers better temperature capabilities and greater environmental resistance.
24.	PSP 6002	This polystyrilpyridine resin is a heterocyclic aromatic polymer which appears to offer very good high temperature performance. It was developed in France.
25.	Ryton	This polyphenylene sulfide material retains good mechanical property levels up to 300°F (149°C), has excellent chemical resistance, and is relatively easy to process.

much lower cost. The 5506 resin system was developed by AVCO as a 350°F (177°C) epoxy and was recommended by them for use with the SiC fiber.

The HyE 2034D material consists of Union Carbide's VSC-32 pitch-based graphite fiber in Fiberite's 934 epoxy resin system. The VSC-32 is a low cost 75xl0⁶ psi (517 GPa) modulus fiber which can favorably compete with boron in many applications.

The V378A resin is a 450°F (232°C) polyimide system which was developed by U.S. Polymeric and was of interest to many respondents to our mail and telephone inquiries. Initially, it was intended to characterize the resin on Celion 6000 graphite fiber with a polyimide (NR150B2) size but initial testing by U.S. Polymeric indicated that epoxy sized T300 produced better property levels with V378A. Rather than wait for further development work with other fiber finishes on Celion, it was decided to go ahead with T300 as the reinforcement.

The fifth material selected was HyE 1076J and consisted of Thornel 300 (15,000 filament tow) in Fiberite's new 976 epoxy, a 350°F (177°C) rated resin with better moisture resistance than the 934 system. Originally the fiber desired in this prepreg was Hercules' AS4 graphite in a 12,000 filament tow. This fiber, however, was not readily available at the time and in order to avoid a delay of uncertain duration, the T300 was substituted.

The last material tested was AVCO's 6535-1 graphite/epoxy prepreg system. This consisted of a 160,000 filament tow graphite fiber in a 350°F (177°C) class epoxy resin. Both components were AVCO products.

SECTION 3 TEST PROGRAM AND PROCEDURES

The laboratory efforts required during this program consisted of four generally sequential steps for each of the six materials characterized. These consisted of prepreg physical property characterization, laminate fabrication and specimen machining, laminate physical property characterization, and laminate mechanical and thermophysical property measurements. Each of the test methods and types of specimen used in the determination of these various properties, as well as the panel fabrication and specimen preparation procedures, are described in this section. Procedures or circumstances which were unique to a particular material are discussed in detail in the appropriate part of Section 4.

3.1 PREPREG PHYSICAL PROPERTY CHARACTERIZATION

The standard prepreg physical properties which were measured consisted of volatile content, resin content, and gel time. In addition, flow was measured on some of the materials and high pressure liquid chromatographic (HPLC) analyses were conducted on all but one of the prepregs. The specific test methods used to determine these properties are identified in Table 2 for each prepreg system. Detailed stepby-step procedures for each of the prepreg test methods listed in Table 2 are presented in Appendix B. The summarized prepreg properties themselves are presented in Section 4 for each specific material. These prepreg physical property characterizations were not intended primarily as a means of accepting or rejecting a particular batch of material. Rather, they were conducted to provide the reader with an indication of the normal property levels and variability encountered in purchased prepreg and also to provide a basis for the subsequent assessment of laminate properties obtainable from such prepreg.

TABLE 2
PREPREG PHYSICAL PROPERTY TEST AND SPECIFICATIONS

	Test Specification Identification 1			
Prepreg Material	Volatile Content	Resin Content	Gel Time	Flow
T300/AFR800	HD-SG-2-6006C (5.1.2); Hercules		HD-SG-2- 6006C(5.5) Hercules	HD-SG-2-6006C (5.3.2B); Hercules
sic/5506	4.2.3.3 Adv. Comp. Des. Guide	4.2.3.2.1 Adv. Comp. Des. Guide		
HyE 2034D	QCI-C-V-14 Fiberite	R15 Fiberite	G2 Fiberite	QCI-C-F-42 Fiberite
T300/V378A	QCI-C-V-14 Fiberite	Rl5 Fiberite	G2 Fiberite	
нув 1076Ј	QCI-C-V-14 Fiberite	R15 Fiberite	G2 Fiberite	
6535-1	QCI-C-V-14 Fiberite	R15 Fiberite	G2 Fiberite	

¹Each of the procedures identified in this table are presented in their entirety in Appendix B.

Reverse phase HPLC was used to separate the epoxy and polyimide resins into their constituent components. A 4.6 mm diameter by 25 cm long column packed with Zorbax ODS (by DuPont) was used in conjunction with a mobile phase of dioxane and water. A programmed concentration gradient for the mobile phase was selected for optimum peak separation and analysis time. In this program, the mobile phase started as 100 percent water to precipitate the resin at the head of the column. Increasing percentages of dioxane were added to separate and move the resin components through the column. Since reverse phase chromatography uses a non-polar support and a polar mobile phase, the more polar compounds elute first followed by less polar components as the mobile phase becomes less polar.

Samples for the prepreg physical property tests were obtained from each roll of prepreg taps and three specimens were used for each test. A complete tabulation of these prepreg test results is presented in Appendix B. All of the prepreg used in this program except for the T300/AFR800 was stored at -30°F (-34°C) when not in use and all of the laminates needed for the program were prepared prior to the expiration of the manufacturer's stated storage life of each specific material. In addition, a written record was maintained for each roll of prepreg which noted the cumulative total time the material was exposed to room temperature conditions during the period in which laminates were being fabricated from the tape. The T300/AFR800 material was stored at room temperature since this material was formulated to have extended room temperature storage life.

a.

3.2 LAMINATE PROCESSING AND SPECIMEN FABRICATION

When laminates were to be made, the roll of prepreg was (except for the T300/AFR800 material) removed from the freezer and allowed to warm to room temperature without opening the sealed bag in which the prepreg was contained. This was done in order to eliminate the chance of moisture condensation directly on the prepreg material. After the prepreg had warmed thoroughly to room temperature, it was removed from its package and unrolled on a clean countertop. Pieces were cut from the tape in the required shape and size with a razor and after removing the release paper, carefully layed up in the desired stacking sequence for a particular laminate panel. This stack was then carefully rebagged and returned to the freezer for storage until lamination and curing. Normally ten or more laminates were layed up at the same time to minimize "out time" with the prepreg. When a laminate was to be cured, it was removed from the freezer and warmed to ambient before reopening its storage bag. The prepreg was then removed from the storage bag and incorporated into a

layup stack similar to that illustrated in Figure 1. This layup stack was assembled on the table platen in an autoclave. The detailed curing schedules for each specific prepreg material are presented in Section 4. After lamination and cure, machining diagrams were sketched onto the panel surfaces and individual specimens were cut out of the panels with a diamond cut-off wheel and finish machined to the required dimensions on a Tensile-Cut belt sander. In the case of the silicon carbide reinforced panels, the hardness of the fiber made final specimen machining so difficult that the laminates were finish cut to final dimensions on a special diamond cut-off wheel equipped with an accurately positioned movable table. Specimens from each panel were set aside for measurement of panel physical characteristics.

Most of the mechanical test specimens required doubling tabs in the grip sections. A 1/16-inch thick glass fabric reinforced phenolic laminate material was used for this purpose. Scotchply is specified in the Design Guide for tab material but it proved unsatisfactory for the elevated temperatures. Several adhesives were used to bond the tabs to the specimen. Originally Loctite 306 was used for all tab bonding. When multidirectional ply orientations, which required high loads, were introduced into the program; however, it was found necessary to switch to FM400 as a tab adhesive. M-Bond 200 was used as a tab adhesive cn specimens which were humidity aged prior to testing because these specimens did not require high loads and this adhesive cured rapidly (three to five minutes) at room temperature, thereby minimizing specimen dryout. The FM400 was cured at 325°F (163°C) for one hour. The Loctite 306, when it was used, was cured for 15 minutes at 275°F (135°C). All tabs were clamped in place with spring clamps during adhesive cure.

3.3 LAMINATE PHYSICAL PROPERTY CHARACTERIZATION

Four different physical properties were measured on each laminate to insure acceptable laminate quality. These were

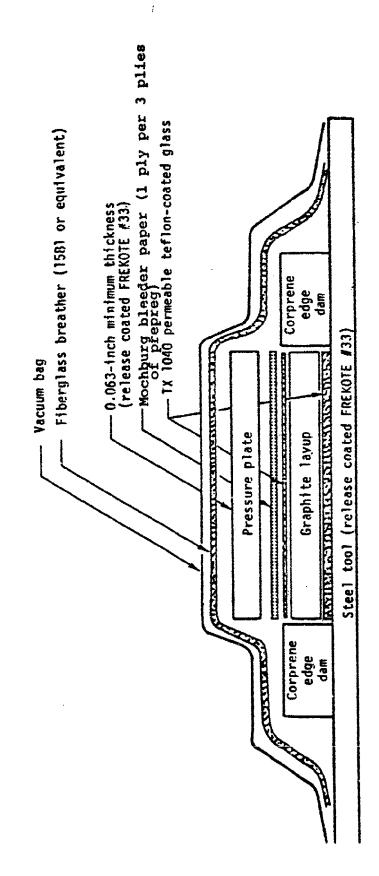


Figure 1. Typical Laminating Layup Stack.

specific gravity, resin content, fiber content, and void content. Each of the procedures used for these measurements is identified and discussed in the following paragraphs. The laminate physical properties obtained for each of the materials investigated are summarized in tables in Section 4 and are presented in their entirety in Appendix C.

3.3.1 Specific Gravity

Three specimens from widely scattered locations on each laminate were selected for specific gravity determinations. Specimen size depended upon both panel size and the number and size of mechanical test specimens required from the panel, but in general ranged from a minimum of 1/2" x 1/2" to a maximum of 1" x 3/4". The method used was ASTM D792, a weight-in-air/weight-in-water technique.

3.3.2 Resin Content

The same specimens which were used for specific gravity measurements were used for resin content determinations. The procedure used involved the digestion of the matrix resin in an acid solution at elevated temperatures. For the five epoxy matrix systems, the acid solution was 70% nitric acid at 145°F (63°C). For the polyimide matrix system (V378A), the digestion solution consisted of a mixture of 96% sulfuric acid and 30% hydrogen peroxide (80:20 volume ratio, respectively, in the mix) at 175°F (78°C).

3.3.3 Fiber Content

The fiber contents of the laminates were computed, as percent by volume, from the same data used for the resin content determinations. The computational procedure is illustrated in AFML-TR-67-243 and employed values for fiber and resin specific gravity reported by the respective manufacturers.

3.3.4 Void Content

The void contents, just as the fiber contents, were computed, as percent by volume, from the same data obtained

in the resin content determinations. The computational procedure is described in ASTM D2734, method B. The result of this procedure frequently gives negative values for laminates having low void contents. This occurs because minor inaccuracies in the values used for resin, fiber, and composite specific gravities become significant at low void contents. A negative result was obtained for numerous laminates made in this program, even though photomicrographs did sometimes reveal the presence of low levels of porosity. Figure 2 illustrates typical laminate cross sections for each of the composite materials characterized.

3.4 SPECIMEN CONDITIONING

Three different types of conditioning were involved in this program. The first was simply a dry dessicated storage of finished specimens at ambient temperature until they were to be tested. This provides a data base for the dry material to which both humidity aging data and data for other materials systems can be compared.

The second type of conditioning was the elevated and reduced test temperatures. In all of the mechanical testing except for specimens which were humidity aged, the specimens were soaked for one-half hour at the test temperature prior to loading. Thermal conductivity specimens were soaked at temperature for periods of from one to several hours in order to provide sufficient time for the test stack to reach thermal equilibrium before readings were taken. The thermal expansion and specific heat specimens were soaked for various periods of time at the endpoints of the test temperature brackets in order to permit stable baseline recordings to be achieved. These periods typically ran from five to 30 minutes in the specific heat tests to one-half to one hour in the thermal expansion tests. The glass transition temperature tests did not involve an isothermal soak since the specimen was heated at a constant rate throughout the test.

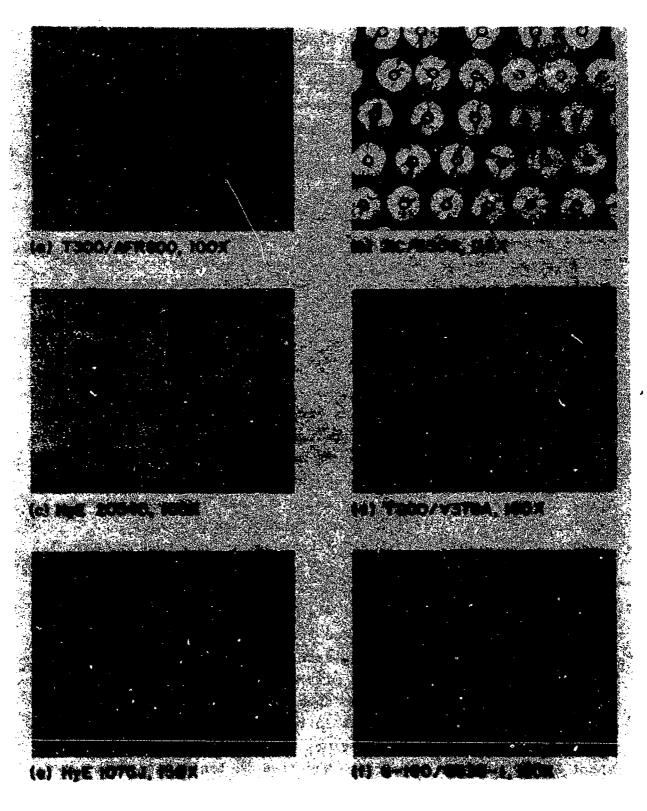


Figure 2. Typical Cross-Sections of Fabricated Composites.

The third type of conditioning was an elevated temperature, high humidity exposure. The specimens involved in these tests were exposed to conditions of 160°F and 100% R.H. until they either reached saturation, as evidenced by constant weight, or about 50% of their saturated weight gain. Specimens were removed from the humidity cabinets for weighing periodically to determine weight gain. The frequency of removal varied from material to material depending upon whether the aging was being carried to saturation or half-saturation and upon the rate and extent of moisture absorption by the particular matrix system being aged. The half-saturation agings, for example, typically required between 18 hours and nine days, depending upon the size of the specimen and the material. Normally two to six weighings were made during this period at various intervals. The fully saturated agings, on the other hand, required from one to 12 weeks to complete, again depending on specimen size and material. Specimens were removed from the aging cabinet and weighed between four and ten times at intervals of three to 14 days. After final removal from the humidity aging, the specimens were tested at both 72°F and at one of the elevated temperatures for which data on dry specimens were obtained. After removal from the humidity aging cabinet, the specimens were kept in a 72°F, 100% R.H. environment until tested (less than one-half day). During this period the specimens were exposed to ambient conditions for a maximum of about 45 minutes, during which time strain gages and gripping tabs were mounted on the specimens (interlaminar shear, short beam specimens of course, did not need this). The specimens tested at elevated temperature were placed in a preheated test oven and tested after a five to ten minute soak at the test temperature. The insertion of the specimens for elevated temperature testing into the grips in the test oven required less than one minute, during which time, the oven temperature fell about 50°F below its setpoint. The five to ten minute soak time was counted from the time the oven temperature returned to its

set point. The test oven required about five minutes to return to its set point. Hence, the humidity aged specimens which were tested at elevated temperature were actually in the test oven for a maximum of 10-15 minutes before testing. It is recognized that any elevated temperature soak of a "wet" composite produces a drying effect so that the test results are not actually representative of a truly "saturated" material. A compromise must be made, however, between the length of time required for a specimen to heat up to the test temperature and the rate at which a specimen dries out. Ideally, a steam test chamber would eliminate the requirement to make such a compromise. Few organizations have such a test chamber, however. dryout which does occur during this period in the test oven results in a moisture concentration gradient through the thickness of the specimen, with the surfaces being "drier" than the interior. Several investigations [1-6] have conducted measurements on various composite materials and developed analytical expressions, based on diffusion studies, which can be used to compute moisture content profiles in "wet" laminates exposed to elevated temperature dryout conditions. No attempt was made in this work to measure the degree of moisture loss which occurred during testing of the "wet" specimens.

with the T300/V378A material, the effect of time-attemperature (350°F, 177°C) before testing was examined on 90°
compression specimens which had been humidity aged to saturation.
Two specimens were tested after 10 minutes and three were tested
after 5 minutes at 350°F (177°C). The 10-minute soak produced
an average strength of 17.0 ksi (117 MPa), while the 5 minute
soak produced an average strength of 20.1 ksi (138 MPa). This
would seem to indicate that the specimens after 10 minutes may
have been nearer to the test temperature than after 5 minutes.
As far as the effect of drying out is concerned, the 5 minute
values should have a higher retained moisture level than the

3.5 LAMINATE MECHANICAL AND THERMOPHYSICAL PROPERTY CHARACTERIZATION

A total of eight types of mechanical property tests were performed on the composite materials evaluated during this program; tension, compression, flexure, inplane shear, interlaminar shear, tensile creep, tensile stress-rupture, and tensile-tensile fatigue. In addition, four thermophysical properties were measured; specific heat, thermal conductivity, coefficient of thermal expansion, and glass transition temperature. Tables 3-6 summarize the test matrices for the various types of tests conducted in this program, indicating the number of specimens tested for each test and test condition.

It can be observed from Tables 3 and 4 that the test matrices for the static and dynamic mechanical tests were not the same for each of the six raterials tested. Two basic changes were made during the program, each of which imposed a different requirement for various numbers of certain tests and ply stacking sequence on the composite systems subsequently tested. These changes affected only the static tensile and the creep and fatigue tests.

It was determined early in the program that there was very little interest in or use for, creep and fatigue data on unidirectional 0° or 90° laminate orientations. Rather, it was determined there was considerably more interest in data on a multidirectional layup consisting of something on the order of 50% 0° plies, 45% ±45° plies, and 10% 90° plies. Even though the stacking sequence, and amount and direction of each ply orientation may be unique to a particular application, there was considerably more interest expressed in creep and fatigue data on any multidirectional layup corresponding roughly to the composition expressed above than in 0° or 90° unidirectional data. Consequently, it was decided to discontinue creep and fatigue tests on the unidirectional

TABLE 3
STATIC MECHANICAL PROPERTY TEST MATRIX

March Dress	Test Material							
Test Type	T300/AFR800	Sic/5506	HyE2034D	T300/V378A	HyE1076J	6535-1		
O° Tension ¹	20	20	20	20	20	20		
90° Tension 1	20	20	20	20	20	20		
±45° Tension¹	20	20	20	20	20	20		
$(0/\pm45/90)$ Tension ² , ⁵	0	15	15	15	15	5		
(0/±45/90) Tension	J					_		
with hole 3,5,8	٥	5	5	5	5	0		
(0/±45/90) Tension ^{3,6}	Ó	0	o	0	ò	5		
$(0/\pm45)$ Tension ³) ⁷	0	0	0	o	o	5		
0° Compression¹	20	20	20	20	20	20		
90° Compression ¹	20	20	20	20	20	20		
0° Flexure ¹	20	20	20	20	20	20		
90° Flexure 1	20	20	20	20	20	20		
Inplane Shear	20	20	20	20	20	20		
Interlaminar Shear*	25	25	25	25	25	25		

¹Five tests each at four different test temperatures.

²Five tests each at three different test temperatures except for 6535-1, in which case all five were at room temperature.

³All five tests at room temperature.

^{*}Ten tests at room temperature, five tests each at other three test temperatures.

⁵ Twenty-ply with stacking sequence (0,45,-45,0,0,-45,45,0,90,0)s.

Twenty-ply with stacking sequence (0,90,45,-45,0,0,-45,45,0,0)s.

Sixteen-ply with stacking sequence (0,45,-45,0,0,-45,45,0)s.

Specimens had a 0.1935 inch (4.91 mm) hole in center of gage section.

TABLE 4

DYNAMIC AND TIME DEPENDENT MECHANICAL PROPERTY
TEST MATRIX

Mant Mana	Test Material T300/AFR800 SiC/5506 HyE2034D T300/V378A HyE1076J 6535-1					
Test Type	T300/AFR800	SiC/5506	HyE2034D	T300/V378A	HyE10763	6535-1
0° Tensile Creep/ Stress Rupture	18 ^{1,4,6}	4 00 640 1440			 45.75	
90° Tensile Creep/ Stress-Rupture	27147			w w =-		
+45° Tensile Creep/ Stress-Rupture	27	27	27	27	27	27
(0/±45/90) Tens. Creep/ Stress-Rupture		27	27	27	27	6 l ₃ 3,5
(0/+45/90) Tens. Creep/ Stress-Rupture						6
(0/±45) Tensile Creep/ Stress-Rupture 10		****				6
0° Tensile-Tensile Fatigue	30 ^{2,4} ,6					
90° Tensile-Tensile Fatigue	30					Miga agair r-Mi
+45° Tensile-Tensile Fatigue	30	30	30	30	30	30
(0/ <u>+</u> 45/90) Tensile- Tensile Fatigue ⁸		30	30	30	30	15 ^{3,4,5}
(0/+45/90) Tensile- Tensile Fatigue with hole ⁸		15	15	15	15	
(0/±45/90) Tensile- Tensile Fatigue						15
(0/+45) Tensile- Tensile Fatigue ¹⁰						15

¹Three tests per stress level.

²Five tests per stress level.

Two stress levels per test temperature.

^{*}Three stress levels per test temperature.

⁵One test temperature.

⁶Two test temperatures.

⁷Three test temperatures.

 $^{^{8}}$ Twenty ply with stacking sequence $[0,45,-45,0,0,-45,45,0,90,0]_{S}$

⁹ Twenty ply with stacking sequence [0,90,45,-45,0,0,-45,45,0,0]s

¹⁰ Sixteen ply with stacking sequence [0,45,-45,0,0,-45,45,0]s

TABLE 5
THERMOPHYSICAL PROPERTY TEST MATRIX

		Test Temperature ¹					
Test Type	-67°F	72°F	тз	T ₄			
Specific Heat	3	3	3	3			
0° Thermal Conductivity	3	3	3	3			
+45° Thermal Conductivity	3	3	3	3			
0° Thermal Expansion	3	3	3	3			
90° Thermal Expansion	3	3	3	3			
+45° Thermal Expansion	3	3	3	3			
Glass Transition Temp. 2 (dry)		3	}				
(wet)		3					

¹The two elevated temperatures varied, depending upon the matrix resin.

TABLE 6
TEST MATRIX FOR STATIC MECHANICAL PROPERTY
TESTS AFTER ELEVATED TEMPERATURE,
HIGH HUMIDITY AGINGS

Test Type	Saturation Level					
tese Type	50%		100%			
	Test	'emperature	Test T	'emperature		
	72°F	T ₃	72°F	T3		
90° Tension	5	5	5	5		
90° Compression	5	5	5	5		
Interlaminar Shear	10	5	10	5		

¹This temperature varied depending upon the specific material.

²Dry refers to the as-fabricated composite condition, while wet refers to the condition of the specimen after it has reached an equilibrium weight gain during humidity aging at 160°F and 100% R.H.

0° and 90° orientations after completion of the work on the first material (T300/AFR800) and to substitute a multidirectional (0,45,-45,0,0,-45,+45,0,90,0)_S orientation instead. In addition, some specimens with this orientation were also to be prepared with a hole in the center of the gage section to obtain an indication of notch sensitivity. The resulting tot matrix was maintained for the next four materials which were characterized (SiC/5506, HyE2034D, T300/V378A, and HyE1076J). At that point another change was made.

During the testing of the multidirectional specimens discussed above, it was noted that the specimens exhibited delamination along the edges at the mid-plane during tensile loading. The point at which this delamination occurred was not recorded until the testing of the last material but occurred at a stress level well below that needed to fracture the specimen. In fact, during fatigue testing, these delaminations were usually dramatically evident long before final failure, or, in the case of some specimens, termination of the tests for residual strength determinations.

The reason for this delamination was the development of tensile stresses, at the free edge of the specimen, normal to the plane of the specimen. These stresses, in turn, arise because of the relative position of the various ply orientations, and the differences in the Poisson's ratio of these different plies. A seemingly innocuous shifting of the position of the 90° plies, or the elimination of them altogether, can drastically change the normal free-edge stress levels in specimens such as those under discussion. Several authors have addressed this issue in the literature and an analysis of the orientations tested in this program and discussion of the effects of alternative ply stacking sequences is presented in Appendix A.

As a result of this consideration, two additional multi-directional orientations besides the original [0,45,-45,0,0,-45,45,0,90,0]_S orientation were added to the static and dynamic test matrix for the last material. In order to offset these additions, the number of tests to be run for each orientation was reduced, as indicated in Tables 3 and 4.

In addition to the number of specimens indicated in Tables 3-6, however, numerous instances were encountered where extra or replacement specimens had to be tested. These situations included instances where failures occurred in the tabbed grip areas rather than in the gage section, where instrumentation failures prevented full data acquisition or aborted a test, or simply occasions when anomalous results were obtained which dictated rechecking. Another source of extra specimen testing involved the creep and fatigue tests. In these tests it was found on several occasions that the stress levels initially selected produced premature failures. Consequently, the stress levels at which these tests were conducted were lowered and extra specimens tested so as to provide the full complement of results required. It will be noted in the summarized results in Section 4 that the number of specimens for which the average property values are reported varies from property to property. As discussed above, in some cases extra tests were conducted which raised the number of specimens above the original plan. In other cases, the behavior of the test specimen during test prevented the acquisition of one or more properties from that particular specimen. If, for example, the specimens underwent excessive elongation before failure, the strain gages were lost and ultimate elongation data were not obtained, even though strength, modulus, proportional limit, and Poisson ratio values were.

In the succeeding sections, descriptions of each of the test methods used to obtain the mechanical and thermophysical properties are presented. The summarized test results for each specific material system are presented in Section 4 and a complete tabulation of all of these test results is presented in Appendices D thru Q.

3.5.1 Tension

Tensile tests were conducted in general accordance with ASTM method D3039. The doubling tabs were a glass fabric/phenolic laminate material as discussed previously (Paragraph 3.2). The tensile tests were conducted at an extension rate

of 0.05 inch/minute (1.3 mm/minute) on an Instron Universal Testing Machine. All of the tensile strains were monitored with strain gages. This test procedure corresponds to ASTM method D3039 except for the tab materials. In the ASTM specification, the tab material called for is a non-woven 0°/90° Scotchply material 1/8 inch thick, while in this program a woven glass/phenolic material 1/16 inch thick was used satisfactorily.

Unidirectional 0° specimens were one-half inch (12.7 mm) wide while specimens with all other orientations (90°, +45°, or multidirectional) were one inch (25.4 mm) wide.

The tensile proportional limits were determined with the understanding that the proportional limit should represent the point at which a significant departure from linearity in the slope of the stress-strain curve, presumably indicative of damage to the specimen, occurs. This can produce a substantially different value than if one were to simply take the point of first deviation from linearity. The first deviation of the stress-strain curve from linearity on the 0° fiber orientations actually occurred at roughly one-third of the ultimate stress but at this point the slope of the curve increased rather than decreased. It is generally conceded that this phenomena is due to the behavior of the reinforcing graphite fiber since the same behavior is noted when testing bare graphite fibers. Consequently, this is not felt to indicate damage to the specimen. No decrease in the slope of the stress-strain curve was in fact noted for most of the 0°, 90°, or multidirectional fiber orientations prior to failure except for the high temperature tests on the 90° fiber orientations, and for this reason the porportional limit is reported as equivalent to the ultimate strengths. On some of the high temperature tests with the 90° fiber orientations, on all of the +45° fiber orientations and on all of the SiC/5506 specimens, a significant decrease in the slope of the stress-strain curves was observed below the ultimate strength. Whether this indicates the onset of real and significant damage, at least at the point of first departure, or simply the onset of nonlinear behavior, is a moot point.

The Poisson's ratio values were experimentally measured on all but the 90° fiber orientation. For this, it was computed from the relationship:

$$v_{21} = v_{12} \left(\frac{E_{22}}{E_{11}} \right)$$
, where

 v_{21} = Poisson's ratio of a 90° fiber orientation,

ν₁₂ = Poisson's ratio of a 0° fiber orientation,

E22 = Elastic modulus of a 90° fiber orientation, and

E₁₁ = Elastic modulus of a 0° fiber orientation.

3.5.2 Compression

Compression tests were conducted in accordance with ASTM method D3410 except that the tab material was the same glass/phenolic material that was used in the tension tests. The compression tests were conducted at a speed of 0.05 inch/minute (1.3 mm/minute) on an Instron Universal Testing Machine. Prior to adoption by ASTM, this test method was widely referred to as the Celanese compression coupon test method.

Compression testing has traditionally been the subject of considerable controversy because of the various types of failure modes one can encounter. Not only can one obtain different failure modes with different types of test specimens and fixtures, but one can also experience different types of failure modes from the same type of test specimen and fixture. Inherent in the question of what is or is not a desirable failure mode is the requirement to avoid a gross specimen buckling-type of failure. This is different from what is called microbuckling, which consists of longitudinally oriented reinforcing fibers undergoing individual, localized buckling due to compressive stresses within the composite exceeding the capability of the resin matrix to support the fiber and maintain its axial alignment. Microbuckling is generally considered a legitimate compressive failure mode, while gross specimen buckling resulting from column instability is not. In order to eliminate the occurrence of column instability failures, specimens are designed with a slenderness ratio

sufficient to insure compressive failure before the load necessary to initiate column buckling is reached. Clark and Lisagor^[7] recently examined three different compressive test methods for graphite/epoxy composites. The effects of specimen size, support arrangement, and method of load transfer were investigated. Their conclusion was that no single test fixture appeared to be universally adequate. Each of the three techniques studied exhibited the potential to provide reliable compressive properties data in certain instances. A method using what is designed as an IITRI (Illinois Institute of Technology Research Institute) fixture was found to provide the most consistent data for unidirectional and quasi-isotropic laminates while a face supported fixture provided the most consistent results for (+45/+45) s specimens.

The compression test described in D3410 is similar to that described in Clark and Lisagor using the IITRI fixture. The principle difference is that the IITRI fixture utilizes flat wedge type grips while the grips in D3410 are conical wedges. One objection to this test method which has been raised is that the mated conical surfaces make line rather than surface contact during testing and that this produces frictional and alignment problems which affect the recorded results. [8] Our experience has been that the frictional problems are minimal except when testing at reduced temperatures. In this case, frost accumulates on the fixture and the sliding surfaces do not slide freely, producing some spurious load recordings although use of a low temperature lubricant reduces the problem substantially. Misalignment has proven to be a problem, however. Although the specimens were designed to eliminate buckling instability, it has been found that buckling sometimes occurred anyway at stresses between 75% and 100% of ultimate. This behavior was indicated by strain reversals on the loadstrain curve and by nonsymmetrical deformations present in failed specimens. The misalignment is induced by the nonuniform seating of the fixture cone in the conical socket. This nonuniform seating, in turn, results from the distortion imposed upon the split cone by the thickness of the specimen.

principal advantage of the IITRI flat-wedge fixture over that called for in D3410 is the elimination of the wedge-socket seating and alignment problem.

We have found, however, that increasing the specimen thickness does reduce the amount of buckling which occurs with the conical wedge fixture of D3410. Apparently, the increased column stability obtained with greater thickness more than offsets alignment problems due to the increased distortion of the split cone produced by the specimen thickness. An increase in specimen thickness from 0.080 inch (2.0 mma) to 0.110 inch (2.8 mm) resulted in a reduction of the incidence of specimen buckling from 60% to only 15% of the total number of specimens tested, and the bulk of these remaining cases of buckling occurred at -67°F (-55°C), where frictional problems with the sliding surfaces are greatest. Consequently, it is believed that the use of sufficiently thick specimens, with a lubricated surface at temperatures below freezing, makes this test method quite satisfactory for specimens made with unidirectional tape prepreg. Another advantage to using this test method is that the data will be directly comparable to results obtained by other investigators and on other materials since the technique is widely used in the aerospace industry.

3.5.3 Flexure

Most of the flexural testing in this program was conducted using the four-point loading method described in the January 1971 issue of the Advanced Composite Design Guide. [9] In this volume, a three-point technique is recommended for 0° fiber orientations and a four-point technique for 90° fiber orientations. It has been observed, however, that with a three-point loading scheme, one frequently encounters undesirable failure modes under the loading nose and subsequent anomalous strength values on high modulus composite materials with a 0° fiber orientation. For this reason, the four-point method was used, with a few exceptions, for loth fiber orientations in this program. The reason for the exceptions is that shear failures were obtained on some of the materials, particularly

at elevated temperatures, when the four-point method was used. The ratio of shear stress to flexural stress is greatly reduced in three-point loading versus four-point loading, thereby reducing the likelihood of shear failure before flexural failure.

The four-point loading method described in the Design Guide is essentially identical to the ASTM flexure test (D790) except for the testing speed and the locations of the load application points in four-point loading. The Design Guide recommends a blanket testing speed of 0.05 inch/min. (1.3 mm/min.) while D790 recommends a speed which is dependent upon specimen thickness and span-to-thickness (L/d) ratio. For the thicknesses used in this program and a 32:1 L/d ratio, D790 calls for a testing speed of 0.11 inch/minute (2.8 mm/minute) for threepoint loading and 0.13 inch/minute (3.3 mm/minute) for fourpoint loading, although a maximum variation of up to +50% above or below these speeds is permitted. The spacing of the upper loading noses the Design Guide method is equal to one-half the span between the lower supports, while in D790 the spacing of the upper loading noses is equal to one-third of the span. major difference is that the ratio of shear stress to flexural stress is 33% greater in the Design Guide arrangement than in the D790 arrangement.

While a wide range of specimen thickness is permissible according to D790, recent studies at Rockwell^[10] on graphite/polyimide laminates indicated that at both room temperature and 600°F (316°C) flexural strength decreased with specimen thickness in the 0.06-0.10 inch (1.5-2.5 mm) thickness range. Our specimens were 0.070-0.076 inch thick on all of the materials we tested except for the SiC/5506, in which case the specimens were 0.100 inch thick. All of the tests were conducted at a crosshead speed of 0.05 inch (1.3 mm)/minute and at a L/D ratio of 32:1.

3.5.4 <u>Inplane Shear</u>

The inplane shear data were computed from longitudinal and transverse load-strain measurements on a uniaxial

tensile test on a ±45° crossplied laminate. This method is in accordance with ASTM D3518.

The inplane shear stress-strain curve is obtained by a point-by-point conversion of the tensile load and strain data. This converts tensile stress-strain $(\sigma-\varepsilon)$ information to shear stress-strain $(\tau-\gamma)$ data. The shear modulus (G) can then be obtained from the initial slope of the $\tau-\gamma$ curve. The shear modulus can also be computed directly from the tensile elastic modulus (E) and Poisson's ratio (v) of the $\pm 45^{\circ}$ specimen using the basic relationship,

$$G = \frac{E}{2(1+v)}.$$

3.5.5 Interlaminar Shear

Interlaminar shear is another property for which no simple or problem-free test exists. The most widely used test is the short beam shear test described in ASTM D2344. Another test is the opposed double notch specimen with side supports and a third test utilizes torsional loading of a rod but requires special fixturing. Each of these tests is subject to certain objections. The notched specimen is known to have nigh stress concentrations at the notch edges. The torsional specimen is not felt to have a straight line stress distribution at the higher stresses even though this assumption is made in computing the failure strength. The short beam specimen produces high strength values because of its short span and the compressive stresses introduced by the loading nose and supporting points. The stress concentrations and complex stress states present in the short beam specimen are aggravated by the use of a thinner specimen than that illustrated in D2344, a practice common to nearly everyone who conducts this test. Whitney[11] has found that short beam shear specimens tested at a 4:1 span-to-thickness ratio produce higher strengths in 0.125 inch (3.2 mm) thick specimens than in the 0.250 inch (6.4 mm) thickness recommended by D2344. He further feels that common failure modes for specimens of this type, particularly in thinner sections, is not normally in interlaminar shear at the midplane, but rather near the top of the specimen and due to a complex interacting stress state. An alternative test method for interlaminar shear, which has produced clear mid-plane shear failures at stress levels near those achieved with a 0.250 inch (6.4 mm) D2344 specimen, has been investigated by Whitney. It consists of a four-point bending test with a 16:1 span-to-thickness ratio for graphite composites. The upper loading noses are spaced half as far apart as the two lower supposits. It is felt that the mid-plane stress state is simpler and more nearly pure shear on this type specimen than on the short beam specimen and that so long as the ultimate failure mode is indeed a mid-plane shear failure, one generates realistic shear strength values. The only problem which has been encountered with this test is that ductile matrices (i.e., polysulfone) produce tensile failures on the lower surface before shear failure occurs at the mid-plane.

In spite of the admitted shortcomings with the short beam shear test using specimens thinner than 0.250 inch (6.4 mm), it was decided in this program to use a thin short beam shear specimen for interlaminar shear because it would better enable the generated data to be compared to other composite material data.

3.5.6 Tensile Fatigue

Fatigue tests were conducted on the fiber orientations indicated in Table 4. Where 30 specimens are indicated, 15 tests were conducted at room temperature and 15 at elevated temperature. Where only 15 specimens are indicated, all were conducted at room temperature. Each group of 15 was subdivided into three groups of five, each of which was tested at a different maximum stress level. Five replications were run for most conditions. In some cases, however, the 15 specimens were distributed differently due to an effort to avoid lifetimes that were either too short (<5,000 cycles) or too long (>2x106)

cycles). In these cases, data were obtained at more than three stress levels and less than five specimens were tested at some of the stress levels. The same type of specimen was used for fatigue as was used for tensile tests. All of the tests were constant load amplitude at a frequency of 10 Hz with the minimum stress equal to one-tenth the maximum stress. The specimens were cycled to a maximum of 10⁷ cycles, at which time, if no failure had occurred, they were removed and tested for residual tensile properties. All residual property tests were conducted at 72°F, regardless of the temperature at which the specimens were fatigue loaded.

The fatigue lifetimes (number of cycles) reported in Tables 17, 31, 44, 58, 71, and 86 represent log-mean values of the individual specimen values for each stress level. Similarly, the straight lines plotted through the individual data points in Figures 20, 21, 22, 38, 39, 40, 55, 56, 57, 71, 72, 73, 87, 88, 89, 104, and 105 represent a least squares fit of the maximum cyclic stress versus log (cycles to failure), with maximum cyclic stress considered the independent variable (x) and log (cycles to failure) considered the dependent variable (y) in the least squares linear equation y = a + bx.

The fatigue tests were carried out on MTS, closed-loop, electrohydraulic, servo-actuated testing machines. Specimen gripping was by means of wedge-type Instron grips. The grips are locked into place on the loading ram and load cell to insure constant alignment. Axial and concentric alignment of the ram and load cell was verified with a dial gage to within 0.001 inch and grip alignment was insured by the use of a specially machined straight aluminum bar in place of a specimen. Spacers were utilized to center the one-half-inch wide 0° specimens in the one-inch wide jaws and periodically, a specially strained gaged specimen was placed in the grips and the strairs on opposite sides and edges monitored during loading to insure that eccentric loading was held below 1 percent.

Both room and elevated temperature tests were conducted in Instron circulating air environmental test cabinets. Temperature control in elevated temperature tests was maintained with Instron oven proportional temperature controllers with chromel/alumel thermocouples positioned directly adjacent to the specimen gage section.

An additional thermocouple was taped against the specimen surface in the center of the gage section to monitor specimen temperature. This was done because fatigue loading of specimens with off-axis ply orientations results in the generation of internal heat due to large repetitive deformations. Specimen surface temperatures as much as 25-30°F (14-17°C) greater than surrounding air temperature have been observed on +45° layups on the materials tested in this program. On the multidirectional layups (0/+45/90), specimen surface temperatures as much as 60°F (33°C) above surrounding air temperature have been measured.

3.5.7 Tensile Creep

Creep tests were conducted on the fiber orientations indicated in Table 4. Where 18 specimens are indicated, nine tests were conducted at each of two elevated test temperatures. Where 27 specimens are indicated, nine tests were conducted at each of three test temperatures (room temperature and two elevated temperatures). In each of these cases the nine-specimen groups were further subdivided into three groups of three specimens each and each of these tested at a different stess level. Where only six specimens were indicated, all tests were conducted at room temperature. Each of these groups of six were subdivided into two groups of three and these were then tested at two different stress levels.

The same specimen design used in tensile testing was used for the creep tests. Creep strain measurements were recorded using one-inch long strain gages and were carried out to a maximum of 500 hours, at which time, if a specimen had not

fractured, it was unloaded and creep recovery measurements recorded for a period of three hours. Each of these surviving specimens was then tested for residual tensile properties at 72°F. It will be noted that the creep recovery data are not included in the tabulated summaries of Section 4. The recovery data are presented, however, in Appendix J.

The creep tests were carried out on Arcweld creep frames. Each frame has the capacity, through a 20:1 counter-balanced lever arm, of putting loads of up to 12,000 lbs. on the test specimen. Each frame is also equipped with an electric timer and automatic shutoff switch, which monitors the total creep time as well as time to failure. Each frame also has an electrically driven load weight elevator and self-aligning couplings.

Specimen gripping was by means of serrated face jaw type grips. The 90° and ±45° orientations were held in grips where the serrated grip faces were tightened against the loading tab material by means of set screws. The 0° and (0/±45/90) orientations were held in wedge-type jaw grips.

Elevated temperature creep tests were conducted in short tube-furnaces (Figure 3).

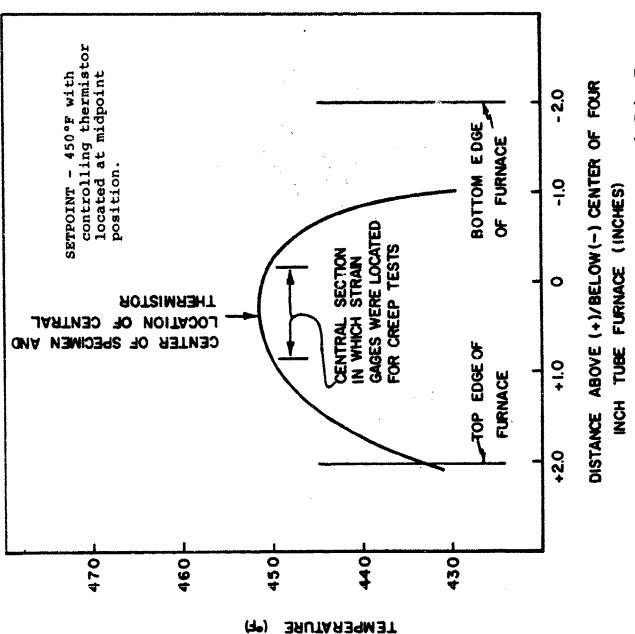


Figure 3 . Short Tube-Furnace Used in Elevated Temperature Creep Tests.

With these short furnaces (four inches long and one and one-half inches diameter tube), only the gage section of the specimen was in the heated zone. Temperature control on these tube furnaces was maintained with a thermistor actuated, time-proportioning controller employing a zero crossover switching triac, and transient fluctuations were less than +3°F around the setpoint. The temperature controlling thermistor was mounted on the side of the one inch wide test specimens and the specimen centered in the uniform temperature region of the furnaces. Additionally, three thermocouples were attached to the specimen, one next to the thermistor and the other two at a distance of one-half inch on either side of the thermistor to insure that the thermistor was at the optimum location. Figure 4 presents a typical temperature profile of the tube furnaces used for these tests. It can be seen that the central two-inch portion of this type tube furnace maintains a relatively "flat" temperature profile which is within +5°F of the setpoint. Specimens were stabilized at the test temperature for at least two hours before the load was applied.

Strain measurements were obtained from one-inch long strain gages mounted on the specimen surfaces and wired into a Vishay model P-350A digital strain indicator through a Vishay model SB-1 ten-channel switch and balance unit. Compensation for thermal expansion during elevated temperature tests was achieved by utilizing a compensating gage on a short section of unstressed specimen material taped to the gage section of the actual test specimen. The output from this compensating gage was fed into an adjacent leg of a half-bridge circuit.

Many of the creep specimens were tested in a series loading arrangement of up to three specimens in order to increase the rate of data acquisition. Figure 5 illustrates such an arrangement. In cases where one of the specimens in a series broke prior to the 500-hour termination point, the remaining specimens were replaced and new tests conducted.



Typical Temperature Profile of Four-Inch Tube Furnaces. 4. Figure



Figure 5. Stacking Arrangement for Testing Three Creep Specimens Simultaneously.

It will be noted in the tables in the text, as well as in Appendix J, that many creep specimens failed on loading even though the applied stress was less than the strength obtained in the static test at the same temperature. The only factor to which this can be attributed is that the creep load was applied at a considerably more rapid (though not instantaneous) rate than the load applied during the static test. The reason for this is that the load pans on the creep frames are raised and lowered by a motor driven elevator, which operates much more rapidly than the 0.05 inch (1.3 mm)/minute rate utilized during static testing.

3.5.8 Tensile Stress Rupture

Stress rupture data were obtained from the same specimens used for the creep tests, the only difference being that time-to-failure rather than strain as a function of time was the measured variable of interest.

3.5.9 Specific Heat

Specific heat was measured with a Perkin-Elmer DSC-2 differential scanning calorimeter. This technique compares the rate of heat input required to maintain a constant rate of temperature rise in an unknown sample to that required to maintain the same rate of temperature rise in a known reference material.

The tests conducted in this program utilized sapphire as a reference material for tests at room temperature and above and benzoic acid for subambient tests. Samples consisted of a single ply of cured prepreg material. (10 mg maximum) circular piece was cut from the single ply of material. The test was conducted by equilibrating both sample and reference material at a temperature about 25°C (45°F) below the temperature at which a specific heat value is desired. Both are then heated at a rate of 10°C (18°F)/min. to a temperature about 25°C (45°F) above the measurement temperature and reequilibrated at this new temperature.

Relative heat capacity values were measured on the ordinate scale of a strip chart recorder for both the sample and reference material. Specific heat of the sample is computed from:

$$Cp,s = \left(\frac{W_r}{W_s}\right) \left(\frac{D_s}{D_r}\right) Cp,r$$

where:

Cp,s = specific heat of the sample

Cp,r = specific heat of the reference

 W_s = weight of sample

Wr = weight of reference

D_s = displacement of sample curve from baseline

Dr = displacement of reference curve from

The displacement of the respective curves from the baseline are illustrated in Appendix L, which also illustrates the treatment of a sloping baseline and a sample calculation.

3.5.10 Coefficient of Thermal Expansion

Thermal expansion was measured using a Perkin-Elmer Model TMS-2 Thermomechanical Analyzer (TMA). The TMA instrument has been specially modified to isolate it from external vibrations and has been fitted with a special chamber to house the sensitive electronic components in an isothermal environment. With these modifications, the instrument is capable of coefficient of thermal expansion (CTE) measurements as low as $10^{-7}/^{\circ}$ C. Without these modifications, at least one order of magnitude sensitivity is lost.

one dimension (i.e., length) of a material, as a function of temperature. For low CTE materials (less than $10^{-5}/^{\circ}$ C) it is important for the test sample to have its ends carefully machined to a flat and parallel condition. A free-floating probe, attached to a linear variable differential transformer (LVDT), rests on the test sample, contained within a stationary sample tube. A furnace can be raised or lowered around the sample tube. A thermocouple is located as close as possible to the sample for temperature measurement independent of the furnace control.

The test is time-consuming since the sample and system must be brought to thermal equilibrium before the measurement is made. This requires from one to seven hours, depending on the temperature level and sensitivity level at which the test must be conducted. For materials with low CTE values, the system must be calibrated by conducting a run without a sample. The change in probe position must be subtracted from that measured with the sample in place in order to obtain an accurate value for the sample alone. This is necessary because of sensitivity of mechanical linkages in the system to temperature changes. As CTE increases this component becomes negligible.

The CTE values reported in Section 4 for the various materials were obtained by equilibrating the sample at a temperature 40°C below the temperature at which a value

was desired, and heating it to an equilibrium condition at a temperature $40\,^{\circ}\text{C}$ above the desired temperature. The difference in recorded probe position for the two equilibrium positions is converted to a change in sample length (ΔL) and for the $80\,^{\circ}\text{C}$ temperature change (ΔT), a CTE value is computed from the standard equation:

 $\alpha = \frac{\Delta L}{L_O \Delta T} \qquad \text{where:} \quad \alpha = CTE$ $\Delta L = \text{change in sample length}$ $L_O = \text{original sample length}$ $\Delta T = \text{change in temperature.}$

3.5.11 Thermal Conductivity

Thermal conductivity was measured in the direction normal to the laminate surface for both unidirectional and +45° fiber orientations. A comparative technique was employed in which the sample is sandwiched between two identical reference materials of known conductivity. These, in turn, are held firmly between a heater and a heat sink. The heat flux through this stack establishes a temperature gradient which is measured with thermocouples placed on the upper and lower surfaces of both reference plates and the specimen plate in small precisely machined grooves. Radial heat flow to and from the test stack is minimized with a cylindrical quard heater in which a linear temperature gradient, closely matching that of the test stack, is maintained. A Dynatech Model TCFCM-N20 thermal conductivity instrument was used for these measurements. Data points were taken at approximately equal temperature intervals over the range of interest and a "best-fit" curve (or straight-line) plotted through these data points. The reported values in Section 4 were taken from these plotted curves at the specific temperatures. The maximum scatter of the individual data points on either side of the plotted curves was about +15% of the reported values.

3.5.12 Glass Transition Temperature

Glass transition temperatures (T_g) were measured with a DuPont Model 981 Dynamic Mechanical Analyzer (DMA).

A schematic diagram of the DMA system is shown in Figure 6. The mechanical portion of the system consists of two parallel balanced sample support arms made of stainless steel, and free to oscillate around flexure pivots. The arm-pivot system is constructed in such a way to give it a very low natural free oscillating frequency (less than 3 Hz).

The sample, in the form of a rectangle, is clamped between the arms as shown to form a compound resonance system, the resonant frequency of which is dependent almost entirely (because of the low natural resonant frequency of the arm-pivot system) on the configuration and modulus of the sample. In oscillation, the sample is deformed as illustrated by the geometry in Figure 7. In the equilibrium position, before oscillation, the sample, the centerlines of the two arms, and an imaginary line connecting the centers of the two flexure pivots form a rectangle represented by the broken lines.

If the compound resonance system is deflected away from the equilibrium position to a new position (represented by the solid lines in Figure 7). the two ends of the sample remain parallel to each other and perpendicular to the arms. The center of gravity of the sample and of the arms, however, translate to new positions. During each cycle the sample is subjected to an alternating flexural deformation. The solution for the dynamic equation of motion for the system gives the relationship between Young's modulus and frequency:

$$E = \frac{(4\pi^2f^2J - K)}{2W\left[\frac{L}{2} + D\right]^2} \left[\frac{L}{T}\right]^3, \quad \text{where}$$

E = Young's modulus (Pa),

f = DMA frequency (Hz),

J = Moment of inertia of arm (kg·m²),

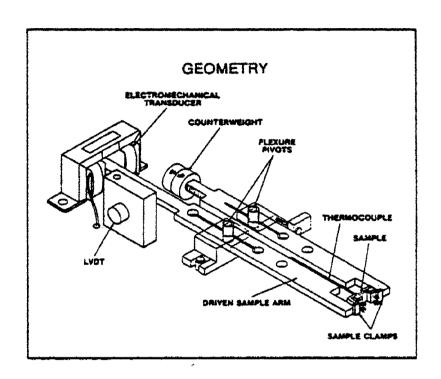


Figure 6. Test Geometry for DuPont 981 Dynamic Mechanical Analyzer (DMA).

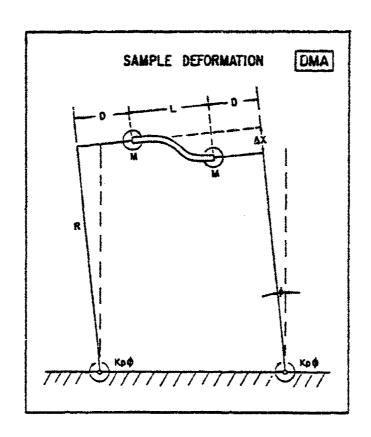


Figure 7. Sample Deformation in DuPont 981 DMA Apparatus.

K = Spring constant of pivot (N·m/rad),

D = Clamping distance (m),

W = Sample width (m),

T = Sample thickness (m), and

L = Sample length (m).

Sample loss factor, n, is calculated from

$$\eta = \frac{CV}{f^2}$$
, where

V = DMA Damping Signal (mV),

f = DMA Resonant Frequency (Hz), and

 $C = System Constant (\sim 0.25 Hz^2/mV)$.

To make a measurement, a sample of known dimensions is clamped between the two sample arms. The sample-armpivot system is oscillated at its resonant frequency by an electromechanical transducer. The frequency and amplitude of this oscillation are detected by an LVDT positioned at the opposite end of the active arm. The LVDT provides a signal to an electromechanical transducer, which in turn keeps the sample oscillating at constant amplitude. Sample resonant frequency (measured to 0.01 Hz) and damping (measured to 0.1 dB) signals are supplied to the temperature programmer/recorder where they are graphically recorded as a function of the measured sample temperature or time. Young's modulus for the sample can be obtained from resonant frequency by using the relationship in the Equation and loss factor can be obtained from the Equation.

In this program, T_g values were defined as that temperature at which the loss modulus is maximum. Loss modulus, in turn, is defined as

$$E' = \frac{E}{\eta}$$
, where

E' = loss modulus,

E = Young's modulus (from the first equation), and

 $\eta = loss$ factor (from the second equation).

Specimens were run both "dry" and "wet", the "wet" condition implying that the sample was humidity aged at 160°F and 100% R.H. to an equilibrium weight gain prior to the determination. Unfortunately, there was no way to prevent the "wet" specimen from drying somewhat during the test. Hence, the specimen was no doubt at some moisture content less than saturation when the indicated Ta was observed. Nonetheless, the "wet" values were lower than the "dry" values in five of the six cases, indicating a definite softening due to whatever moisture level still remained in the sample. In the one exception, the T300/V378A system, the composite gained weight during moisture aging very rapidly compared to the epoxy systems, although the total weight gain was only slightly higher. It would not be unreasonable to assume that, when heated, this material would lose absorbed moisture much more rapidly than the apoxy systems also. This, coupled with the fact that the Ta value for the V378A resin is substantially higher than those measured for epoxies (by 200-300°F) would make it reasonable to speculate that the so-called "wet" V378A sample has completely dried out by the time its Tq is reached, thereby resulting in identical To values being determined for both the "dry" and "wet" samples.

SECTION 4 SUMMARIZED COMPOSITE DATA

This section presents tabulated summaries of all the data generated for each composite system evaluated during the program. Also presented are the averaged stress-strain, creep, and fatigue S-N curves for each of the systems.

In addition to the summarized data and averaged mechanical property curves, pertinent observations made during the characterization of each material are discussed.

4.1 T300/AFR800

The matrix resin in this system was developed under USAF contract by the Aerotherm Division of Accurex Corporation. [12,13] The objective was "to achieve state-of-the-art performance (350°F [177°C]) from graphite fiber reinforced composites coupled with prelonged prepreg flow life under ambient shop conditions." This was basically achieved by utilizing aromatic diamine curing agents with "attenuated reactivity and limited solubility in the resins."

The resin was prepared according to the Aerotherm recipe by Hexcel (Dublin, California) and was also prepregged by Hexcel.

Tables 7 through 18 present the data generated for this graphite-epoxy composite system. Figures 8 through 22 illustrate the stress-strain, fatigue, and creep behavior of this material as well as the effects of humidity aging upon selected composite properties.

TABLE 7
PROCESSING CONDITIONS FOR T300/AFR800 COMPOSITE LAMINATES

Composite Processing Information

Material System - T300/AFR800 Fiber - T300/ Matrix - AFR800¹ Maximum Rated Temperature - 350°F

Graphite/Epoxy

Prepreg by - Hexcel

Laminate Processing Schedule

Layup Procedure: The prepreg was stored in a closed wrapper at room temperature. Prepreg was removed from wrapper and plies cut to desired size using a razor knife. Plies were stacked in the desired sequence (release paper removed from each ply). The stack was placed in the autoclave according to the layup system illustrated in Figure 8. The corprene edge dam serves to restrict fiber flow.

Cure Schedule: Apply full vacuum and hold for one hour at room temperature. Heat to 275°F in 60 + 5 minutes under at least 10 inches Hg vacuum. Hold at 275°F for 50 minutes less than the gel time. Apply 75 psi and vent vacuum at the end of this hold time. Heat to 325°F in 30 + 5 minutes. Hold at 325°F for four hours. Cool under pressure to 120°F.

Postcure Schedule: The panels were placed, unrestrained, in an oven at room temperature. The oven was brought to 375°F at rate of about 5°F/min. After a four-hour hold at 375°F, the oven was turned off. When the oven was cooled to near room temperature, the panels were removed.

Resin development and composition is described in AFML-TR-77-158.

This cure schedule is given in AFML-TR-77-158, where it is stated that the key processing parameter is the point of pressure application at the 275°F hold temperature. This, in turn, depends upon the gel time. We have found that gel time has depended upon the method used for the measurement. The Hercules method (HD-SG-2-6006C, para. 5.5), in which a prapreg sample is rolled up in aluminum foil, gave a gel time of 140 minutes. The Fiberite method (Fisher-Johns melting point apparatus) gave a gel time of 87 minutes.

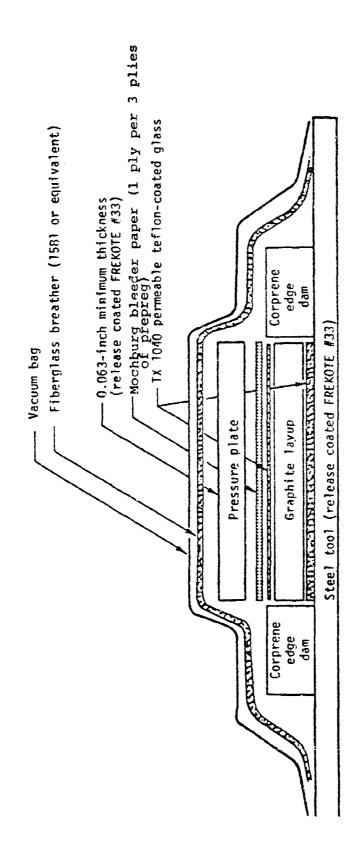


Figure 8. Layup System for AFR-800 Laminates.

TABLE 8
PREPREG AND COMPOSITE PHYSICAL PROPERTIES

Composite Ph	ysical Prope	erty Inform	ation	
Material System - T300/AFR-E Fiber - T300 Matrix - A			Graphite/Ep	рожу
Maximum Rated Temperature -	repreg by - Hexcel			
Prepre	g Physical F	Properties		
(Property)	(Stnd.Dev.)	(Range)	(Test Method)	(Ref.)
Volatile Content- 0.11%		0.07-0.18	HD-SG-2-6006C (5.1.2)
Resin Content- 40.1%			HD-SG-2-6006C (
Resin Flow- 15.51% ²			HD-5G-2-6006C (
No. of Rolls Involved- 1 No. of Batches Involved- 1	_			3.3.26/1
No. of Rolls Involved- 1 No. of Batches Involved- 1	_	Hercules to	est methods	
No. of Rolls Involved- 1 No. of Batches Involved- 1	e Physical I	Hercules to	est methods 	
No. of Rolls Involved- 1 No. of Batches Involved- 1 Laminat No. of Panels- 36	e Physical I	Properties 1	est methods	(Ref.)
No. of Rolls Involved- 1 No. of Batches Involved- 1 Laminat No. of Panels- 36 Fiber Content- 69.1% by vol.	e Physical F (Stnd.Dev.)	Properties (Pange) 61.1-77.0	(Test Nethod) Acid Digestion	(Ref.)
No. of Rolls Involved- 1 No. of Batches Involved- 1 Laminat No. of Panels- 36	e Physical F (Stnd.Dev.)	Properties (Pange) 61.1-77.0 23.5-33.1	(Test Nethod) Acid Digestion	(Ref.)
No. of Rolls Involved- 1 No. of Batches Involved- 1 Laminat No. of Panels- 36 Fiber Content- 69.1% by vol. Resin Content- 26.6% by wt. Void Content- 0.2% by vol.	2.8 0.8 0.8 0.8	Properties 1 (Pange) 61.1-77.0 23.5-33.1	(Test Nethod) Acid Digestion AFML-TR-67-243 D2734	(Ref.)
No. of Rolls Involved- 1 No. of Batches Involved- 1 Laminat No. of Panels- 36 Fiber Content- 69.1% by vol. Resin Content- 26.6% by wt. Void Content- 0.2% by vol. Laminate Sp. Gr 1.60	3.7 2.8 0.8 0.04	Properties (Pange) 61.1-77.0 23.5-33.1 0-4.4 1.54-1.71	(Test Nethod) Acid Digestion AFML-TR-67-243 D2734 D792	(Ref.)
No. of Rolls Involved- 1 No. of Batches Involved- 1 Laminat No. of Panels- 36 Fiber Content- 69.1% by vol. Resin Content- 26.6% by wt. Void Content- 0.2% by vol. Laminate Sp. Gr 1.60	3.7 2.8 0.8 0.04	Properties (Pange) 61.1-77.0 23.5-33.1 0-4.4 1.54-1.71	(Test Nethod) Acid Digestion AFML-TR-67-243 D2734	(Ref.)
No. of Rolls Involved- 1 No. of Batches Involved- 1 Laminat No. of Panels- 36 Fiber Content- 69.1% by vol. Resin Content- 26.6% by wt. Void Content- 0.2% by vol. Laminate Sp. Gr 1.60	3.7 2.8 0.8 0.04 As reg	Properties (Pange) 61.1-77.0 23.5-33.1 0-4.4 1.54-1.71 ported by m	(Test Nethod) Acid Digestion AFML-TR-67-243 D2734 D792	(Ref.)

The properties reported here represent averages for all panels of this material used throughout the program.

 $^{^2}$ After 30 days storage at R.T., flow was remeasured and found to have increased to 19.32%.

TABLE 9
TENSILE PROPERTIES OF T300/AFR800 COMPOSITE LAMINATES

Composite Material Properties						
Reterial System - T300/AFR 800 Prepteg by - Hexcel Graphite/Epoxy Fiber - T300 Ratrix - AFR 800 Eaximum Rated Temperature - 350°F(177°C) Resin Content - 25.0% by wt. Nominal, Plu Thickness - 0.0051 inch No. of panels from which specimens were tested in this table - 10 Thickness of each type specimen: 0° - 6 ply /: 90° - 15 ply						
TENSION: 0"						
-67°F(-55°C) 72°F(22°C) 760°F(127°C) 750°F (177°C)						
Fill [Msi](MPa) Stnd.Dev.[ksi](MPa) Range [ksi](MPa)	[186.7] (1286) [15.8] (109) [172.2-212.1]	[179.6] (1237) [17.0] (117) [169.6-205.6]	[193.9] (1336) [17.4] (120) [174.3-213.3]	[173.5] (1195) [21.0] (145) [159.7-200.9]		
No. of Specimens	(1187-1461) 5	(1169-1417)	(1201-1470) 5	(1100-1384)		
Fil [Rsi](MPA) Stnd.Dev.[ksi](MPA) No. of Specimens	[186.7] (1286) [15.8] (109) 5	(179.6) (1237) (17.0) (117) 5	(193.9) (1336) [17.4] (120) 5	(173.5) (1195) (21.0) (145) 5		
Ex (Msi)(MPa) Stnd.Dev.(Msi)(MPa) No. of Specimens	[20.87] (143,800) [0.49] (3380) 5	[18.69] (128,800) [0.98] (6750) 5	[20,40] (140,600 [0,44] (3030) 5	[19.87] (136,900) [0.43] (2960) 5		
Ex [win/in](wen/em) Stnd.Dev. No. of Specimens	8520 572 5	8700 648 5	9040 620 5	8380 870 5		
t Yxy Stnd. Dev.	0.319 0.010	0.312 0.034	0.307 0.022	0.355 0.037		
No. of Specimens Test Method Reference	5	S ASTH D30	5 39	5		
	<u> </u>	TENSION: 90°		,		
F ^{tu} [ksi] (MPa)	[4.69] (32.3)	[4.58] (31.6)	(4.68) (32.2)	(5.42) (37.3)		
Stnd.Dev. [ksi] (MPa) Range No. of Specimens	[1.27] (8.75) [2.80-6.31] (19-3-43.5) 5	[1.01] (6.96) [3.20-5.75] (22.0-39.6) 5	[0.50] (3.45) [4.33-5.56] [29.8-38.3] 5	[0.67] (4.62) [4.80-6.53] [33.1-45.0]		
F ^{tpl} (ksi) (MPa) Stnd.Dev.[ksi] (MPa) No. of Specimens	[2.89] (19.9) [1.84] (12.7) 5	{4.17} (28.7) {0.65} (4.48) 5	(3.79) (26.1) [1.21] (8.33) 5	[2.86] (19.7) [1.17] (8.06) 5		
Ey [Nsi] (FPa) Stnd.Dev.[Msi] (MPa) No. of Specimens	(1.63) (11,230) (0.07) (480) 5	(1.48) (10,200) (0.04) (276) 5	(1.36) (9370) (0.04) (280) 5	(1.191 (8200) (0.681 (551)		
E ^{tu} (pin/in)(pcm/cm) Stnd. Dev. No. of Specimens	2870 760 5	3110 720 5	3510 330 5	4910 897 5		
0.025 ¹ 0.025 ¹ 0.020 ¹ 0.021 ¹						
Test Method Reference	ASTM D3039					

Computed using elastic modulus and longitudinal Poisson's ratio.

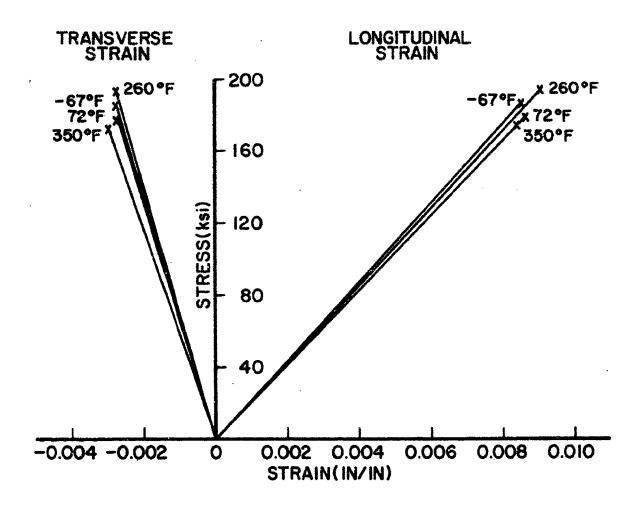


Figure 9. Tensile Stress-Strain Curves for Unidirectional T300/AFR800 Composite Laminates: 0° Fiber Orientation.

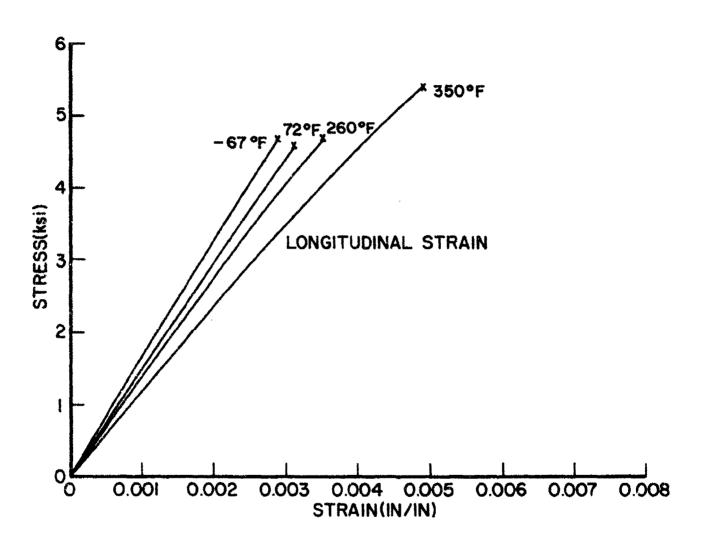
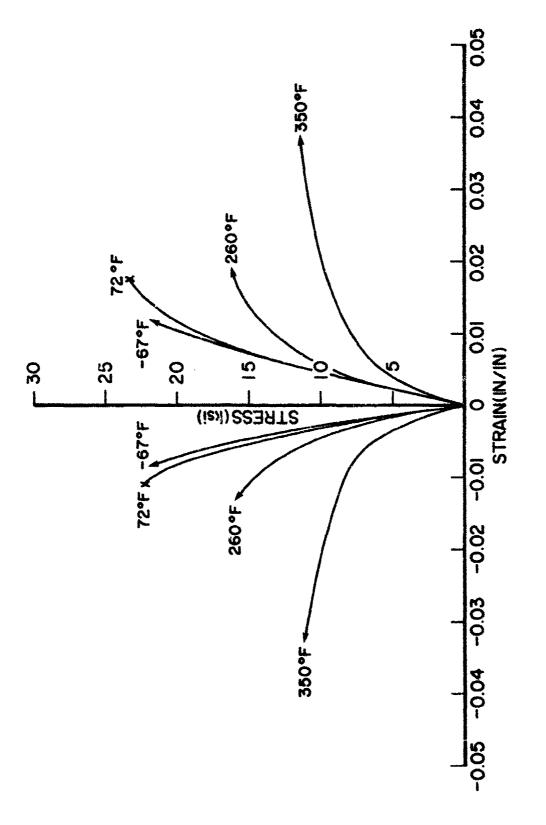


Figure 10. Tensile Stress-Strain Curves for Unidirectional T300/AFR800 Composite Laminates: 90° Fiber Orientation.

TABLE 10
TENSILE PROPERTIES OF T300/AFR800 COMPOSITE LAMINATES

	Composite	Material Propertie	S		
Maximum Rated Temperat Resin Content - 30.5% Fiber Content - 59.8%	ix - AFR 800 ure - 350°F (177°C) by wt.	No. of panels in this tab	Gr 1.57 Thickness - 0.0057 s from which specim	cimens were tested	
	m	ENSION: +45°			
	-67°F(-55°C)	72°F (22°C)	260°F (127°C)	350°F(177°C)	
F ^{tu} [ksi](MPa)	[26.4] (182)	[23.2] (160)	[16.8] (116)	[16.3] (112)	
Stnd.Dev.[ksi](MPa) Range [ksi](MPa)	[1.00] (6.9) [25.2-27.8] (174-191)	{1.03} (7.1) [21.5-24.1] (148-166)	[1.12] (7.7) [15.4-18.0] (106-124)	[0.86] (5.9) [15.3-17.1] (105-118)	
No. of Specimens	5	5	5	5	
F ^{tpl} [ksi](MPa)	[9.37] (64.6)	[4.69] (32.3)	[4.93] (34.0)	[2.13] (14.7)	
Stnd.Dev.[ksi](MPa) No. of Specimens	{2.36} (16.3) 5	{1.14} (7.85) 5	[0.36] (2.48) 5	[0.34] (2.34) 5	
Et [Msi](GPa)	[2.28] (15.7)	[2.35] (16.2)	[2.14] (14.7)	[1.62] (11.2)	
Stnd.Dev.[Msi](GPa) No. of Specimens	[0.12] (0.83) 5	[0.16] (1.10) 5	(0.11) (0.76) 5	[0.12] (0.83) 5	
ε ^{tu} [μin/in] (μcm/cm)	>12,080 ¹	17,630	>21,5% ¹	>39,450 ¹	
Stnd. Dev. No. of Specimens	5	1,630 5	> 7,090 5	š	
ν ^t xy	0.69	0.75	0.78	0.88	
Stnd. Dev. No. of Specimens	0.04 5	0.04 5	C.01 5	0.06 5	
Test Method Reference	ASTM D3039				

 $^{^{\}mathrm{l}}$ Some strain gages lost before completion of test.



Tensile Stress-Strain Curve for Bidirectional T300/AFR800 Composite Laminates: +45° Fiber Orientation. Figure 11.

TABLE 11 COMPRESSIVE PROPERTIES OF T300/AFR800 COMPOSITE LAMINATES

	Composite	Material Properti	es	
Material System - T300 Fiber - T300 Matr Maximum Rated Temperat Resin Content - 24.74 Fiber Content - 71.14 Void Content - 204 Matr Thickness of each type	ix - AFR800 ure - 350°F(177°C) by wt. by vol.	in this tab	Gr 1.61 Thickness - : s from which le -2	Graphite/Epoxy 0.0050 inch specimens were tested
	CO	PRESSION: 0°		
	-67°F(-55°C)	72°F(22°C)	260°F(127°C) 350°F(177°C)
P ^{Cu} [ksi] (MPa)	[205.6] (1417)	[174.6] (1203)	[188.2] (12	97) [164.2] (1131)
Stnd.Dev.(ksi](MPa) Range [ksi](MPa)	[17.0] (117) [186.4-224.8] (1284-1549)	[23.0] (158) [145.6-192.9] (1003-1329)	[29.4] (203 [149.5-220. (1030-1519)	5] [130.4-206.3]
No. of Specimens	5	5	5	5
F _x ^{cpl} [ksi](MPa)	[66.1] (455)	[44.8] (309)	[75.4] (520	(71.3) (491)
Stnd.Dev. [ksi] (MPa) No. of Specimens	[15.0] (103) 5	[38.7] (267) 5	[33.3] (229 5) [53.0] (365) 5
EC [Mai] (GPa)	[19.15] (132)	[15.98] (110)	[18.38] (12	7) [20.71] (143)
Stnd.Dev.[Msi](GPa) No. of Specimens	[2.19] (15.1)	[2.85] (19.6) 5	[3.24] (22.	3) (2.64) (18.2)
ε cu (μin/in)(μcm/cm)	18,300	14,700	14,400	8,300
Stnd. Dev. No. of Specimens	5,600 5	2,430 5	2,000	1,400 5
Test Method Reference		ASTN I	3410	
	col	APRESSION: 90°		
P. [ksi] (MPa)	[44.2] (305)	[39.7] (274)	[28.4] (19	6) [27.7] (191)
Stnd.Dev.[ksi](MPa) Range	(13.8) (95) [23.9-55.8] (165-384)	[4.8] (33) [32.4-45.7] (223-315)	(1.5) (10) [26.7-29.9 (184-206)	[3.9] (27)
No. of Specimens	5	5	5	5
pcpl [ksi] (Mpa)	[13.7] (95)	[32.8] (226)	[18.9] (13	0) [22.3] (154)
Y Stnd.Dev.(ksi)(NPa) No. of Specimens	[6.8] (47) 5	[15.7] (108) 5	[12.4] (85 5) [11.0] (76) 5
E _y [Msi](CPa)	(1.70) (11.7)	[2.50] (17)	[1.50] (10	.3) [2.02] (13.9)
Stnd.Dev.[Hsi] GPa) No. of Specimens	[0.24] (1.7)	[0.27] (1.9) 5	[0.09] (0. 5	6) [0-57] (3.9) 5
ε ^{cu} (μin/in)(μcm/cm)	31,500	17,900+ ¹ 3 ²	12,700+	25.800
y Stnd. Dev. No. of Specimens	6,600 S	9,000	4,400	9,800 5
Test Method Reference		astn	D3410	

 $^{^1\}mathrm{Ultimate}$ strain values represent maximum observed strain rather than ultimate values. $^2\mathrm{Two}$ of five specimens exhibited evidence of buckling.

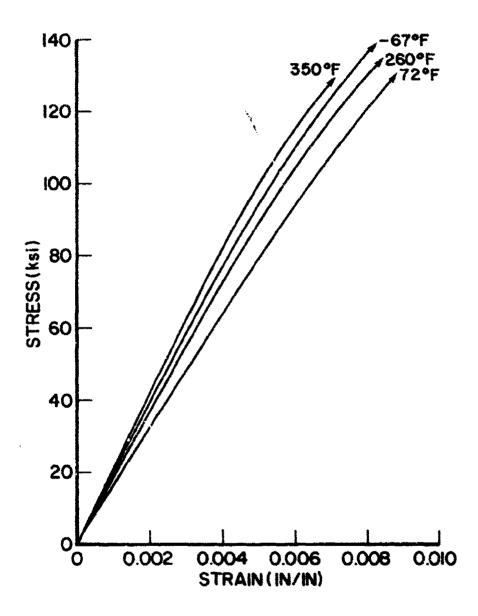


Figure 12. Compressive Stress-Strain Curves for Unidirectional T300/AFR800 Composite Laminates: 0° Fiber Orientation.

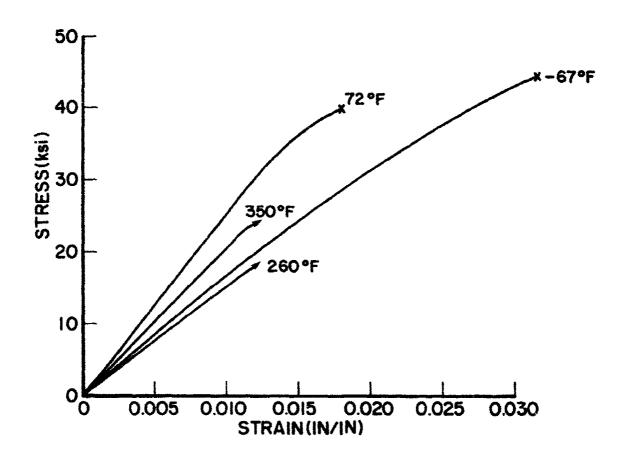


Figure 13. Compressive Stress-Strain Curves for Unidirectional T300/AFR800 Composite Laminates: 90° Fiber Orientation.

TABLE 12
FLEXURAL PROPERTIES OF T300/AFR800
COMPOSITE LAMINATES

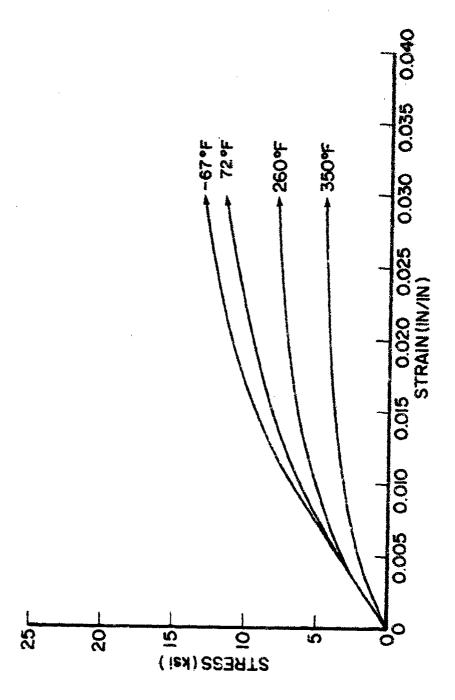
	Composite	Material Propertie	s	
Material System - T300 Fiber - T300 Matr Maximum Rated Temperat Resin Content - 23.8% Fiber Content - 75.5% Wold Content - 40% by Thickness of each type	ix - AFR.800 cure - 350°F(177°C) by wt. by wol. vol.	No. of panels in this tabl	Gr 1.69 hickness - 0.0049 from which specials - 2	ite/Epoxy inch mens were tested
	3	PLEXURE: 0°		
	-67°F(-55°C)	72°F (22°C)	260°F (127°C)	350°F (177°C)
F ^{fu} (ksi)(Ma)	[291.6] (2009)	(280.1) (1930)	[218.2] (1503)*	(186.8) (1287)*
Stnd.Dev.[ksi](MPa) Range [ksi](MPa)	[8.2] (56) [278.1-299.7] (1916-2065)	[4.4] (30) [272.9-284.9] (1880-1963)	[10.9] (75) [206.5-230.0] [1423-1585]	[5.3] (37) [181.3-192.5] (1249-1326)
No. of Specimens	5	5	5	5
Ef [Msi] (GPa)	(20.11)(138.5)	[20.70] (142.6)	[20.82] (143.4)	[19.94] (137.4)
Stnd.Dev. [Msi] (GPa) No. of Specimens	[1.17] (8.06) 5	[0.74] (5.10) 5	[0.42] (2.89) 5	[0.21] (1.45)
Test Hethod Reference	4 pt. flexure Design Guide: Jan	Corresp 1. 1971 Loading	onds to ASTM D790 points and loading	
		FLEXURE: 90°		
F ^{fu} [ksi](MPa)	[14.90] (102.7)	[14.10] (97.1)	[10.68] (73.6)	[11.21] (77.2)
Stnd.Dev.[ksi](MPa) Range [ksi](MPa)	[1.75] (12.1) [13.02-17.71] (89.7-122.0)	[0.36] (2.48) [13.57-14.43] (93.5-99.4)	[0.44] (3.03) [10.21-11.21] [70.3-77.2)	[1.31] (9.03) [9.68-12.80] (66.7-88.2)
No. of Specimens	5	5	5	5
Ey (Msi)(GPa)	[1.67] (11.51)	[1.27] (8.75)	[1.17] (10.53)	[1.13] (7.79)
Stnd.Dev.[Msi](GPa) No. of Specimens	[0.06] (0.41)	[0.04] (0.28)	[0.07] (0.48) 5	[0.08] (0.55) 5
Test Hethod Reference	4 pt. flexure Design Guide: Jan	Corresponding	onds to ASTM D790 opints and loading	except for g speed.

^{*}At the two higher test temperatures, the O* specimens failed by delamination rather than fracture at the lower plies.

The second secon

TABLE 13
SHEAR PROPERTIES OF T300/AFR800
COMPOSITE LAMINATES

	Composite	: Material Properti	.es	
Maximum Rated Temperat Resin Content - 29.4% Fiber Content - 65.5%	rix - AFREOO ture - 350°F(177°C) by wt. by vol. by vol.	No. of panel in this tab	Gr 1.58 Thickness - 0.0 s from which spoke - 6	ecimens were tested
	IN	IPLANE SHEAR		
	-67°F(-55°C)	F(-55°C) 72°F(22°C) 260°F(127°C)		350°F(177°C)
F ^{SU} [ksi] (MPa)	[13.2] (91.0)	[11.5] (79.9)	[8.4] (58.0)	[8.1] (55.8)
Stnd.Dev.[ksi](MPa) Range [ksi](MPa)	[0.50] (3.45) [12.6-13.9] (87.0-95.5)	[0.52] (3.58) [10.8-12.0] (74.4-82.7)	[0.55] (3.79) [7.7-9.0] (53.0-62.0)	[0.43] (2.95) [7.7-8.6] [52.5-59.0)
No. of Specimens	5	5	5	5
Gxy [Msi] (MPa)	[0.68] (4.66)	[0,68] (4.69)	[0.61] (4.22)	[0.43] (2.94)
Stnd.Dev.[Msi](MPa) No. of Specimens	[0,03] (0.18) 5	[0.05] (0.34) 5	[0.03] (0.23 .5	[0.02] (0.14) 5
Test Method Reference		ASTM	p3518	
	INT	ERLAMINAR SHEAR		
pisu [ksi](MPa) Stnd.Dev.[ksi](MPa) Range [ksi](MPa) No. of Specimens	[18.17) (125.2) [0.92] (6.34) [17.27-19.27] (119.0-132.8) 5	[15.27] (105.2) [0.79] (5.4) [14.37-17.16] [99.0-118.2]	[11.77] (81.1) [0.69] (4.75) [11.02-12.81] (75.9-88.3) 5	[9.63] (66.4) [0.33] (2.27) [9.27-10.00] (63.9-68.9)
Test Method Reference	ASTM D2344			

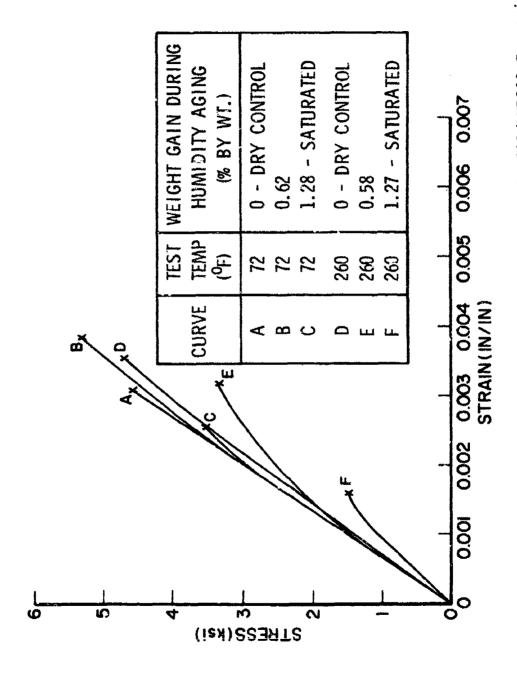


Inplane Shear Stress-Strain Curves for T300/AFR800 Composite Laminates. Figure 14.

TABLE 14
TENSILE, COMPRESSIVE AND SHEAR PROPERTIES OF T300/AFR800
COMPOSITE LAMINATES AFTER HUMIDITY AGING

Mariel Symme - Tilleration	*-	opens by - Heater		بعيواليدد
1984 - 1730 HARLEY - MANGO	i.e.	calenta Mor. Gr.	_ 1-60	
Malern Roard Tonoscotoco - 2007:	CLTTC) ==	ational Phy Thronic	- 0.0051 £	match.
harin Gunton, - 31.44 by ut. Star Contons - 71.75 by wil.	•	named in this t	n wielch synchro dale - 7	
reid Cantains - 2 de ph angr	Age .	ing Contitions -	· 360,54(37,47) *	75-188A S.S.
Midwest of each type specimes	3mmin - 35 g	Phi Congr 20	Jages Spring - y	3 pily
	***	36"		
	BFFFFFF	POTO TO	TENTO.	NOT (LIFE)
Coperate Mina (Maja)	375	294	1436	3940
Heright Codenie of seign day we.]	8.63	9.36 9.39	1.27	3.272
No. of Specimens	***	-	1	
-			ı	}
the limit) (1884)	25.330 (06.5)		(18.52) (24.30)	\$[2.00] (20.3)
Dignell There, Glack J. (Arthur) Company (Mary J. (1984)	30-323 SP-87	HEAD FLAS	(D.41)	(B.21) (1.4)
	34.22-6.373 E28.1~41.93	(2.70-2.40) (74.4-36.7)	(2.765-4.05) (2.765-4.05) (28-6-37-5)	(1.28-1.78) (8.8-12.3)
No. of Apocianas	.5	3	•	
dkail(ffe)				
T Ding.Dov. (kui) (10a)	1		(3.52) (24.3)	1
Ma. W Specimens	(11,76) (7.3) 5	10:00] (0:30)	(2.4)	10-24] (1.7)
*	1	1	1	1
R _E (Mrt) (GM)	(1.49) (20.2)	(1-45) (10-7)	11.45) (10.0)	13-82] (7.0)
Chail-Sher. (Mail) (Cha)	(0.06) (0.41)	10.11) (0.76)	10.67] (0.48)	10.00) (0.55)
Mp. at Specimens	•	5	4	
E ^{dos} (kin/in) (pon/on)				
tend.bev.	3636	2115	2545	1502
No. of Spotimens	545	-883	\$537	401
	_	_	1	1
u ^t . Stad. Dav.	1	1	1	1
No. of Sponisson	{	ı	I	1
Test Hethod	1	•		•
Informe	1	Appa Mas	300	
	Cir@948810	W. 50°		
	,			
Engosuro Timo (hes)	116	364	1.251	1904
Height Gain(t of orig. dry vt.) Stad. Dov. (t)	0.G5	6.67	0.10	1.34 ¹ 0.02
in. of Specimens	5	3	•	4
uille flood i floori	[301.9] (327)	[36.0] (179)	(33.2) (223)	
Par (hai) (Hea)	(3-5) (17)	(1.5) (10)	(32.2) (222)	[24.1] (166)
Stef-Dev. (kgi) (NPL) Bangs	(31.6-36.6)	(24.4-28.1)	(29.7-33.63	(1.5) (10) (22.7-25.9)
_	(210-213)	(169-194)	(206-233)	(156-178)
the of Specimens	1 *	į ·	1 *	•
e ^{sipl} (kni) (spa)	(24-3) (99)	19.73 (67)	D7.11(130)	1122-51 (79)
Send.Dev. (hrij(NDa)	(15.2) (70)	12.07 (20)	(33.8) (95)	(3.2) (3.5)
No. of Specimen	\$ 1,00	3	3	4
	1.	1.	1	1
g ^y (mt)(Grd	(3.270) (3.2)	(2.84) (33)	(3-00) (3.0)	(1.43) (11)
Sint-per. (Mri.) (GPW) Mr. of Specimens	(0-33 ₍₁₎	(0.9) (6)	(8.5) (3)	(0.4) (3)
	1	1	1 -	1
c ^{mo} (pin/in) (pen/em)	43.300	34,340	37,440	13,9te
March, Darry	34,000	13,200	16,700	14,400
Ma. of Specialis	•	1 5	1 ,	1 •
Test Method	1	و	20410	
Referenses.	<u></u>			
	INTER-MINE	NI SHEAR		
Expressive Time (here)	1 27	29	1206	1205
weight Coloft of orig. dry wt.)	0.67	8.70	1.261	1.36
Stel. Bov. (1) In. of Specimen	0.15 20	0.19	9-17 19	9.18 5
-	4	1 "	1	1
Strongth thail (1944)	[15.44] (107.7)	(10.54) (72.8)	H13.76] (84.8)	[7.47] (\$1.5) [0.10] (0.69)
Stad_Bev. [ksi] (1996) Sange (1891) (1996)	[{24.34-28.46]	[10.00-11.19]	Kla.85-16.731	[7.30-7.63]
	(140.3-114.8)	[10.56] (72.6) [0.43] (3.0) [10.66-11.19] [60.5-77.1]	100.5-101.6)	(50.9-57.6)
No. of Specimen	10	*	1 ~	1 ,
Test Rethod	1			
1000		ASTM DE		

ADTES: 1, 1809 saturation at aging conditions.



Tensile Stress-Strain Curves for Unidirectional T300/AFR800 Composite Laminates After Humidity Aging at 160°F (71°C) and 100% R.H.: 90° Fiber Orientation. Figure 15.

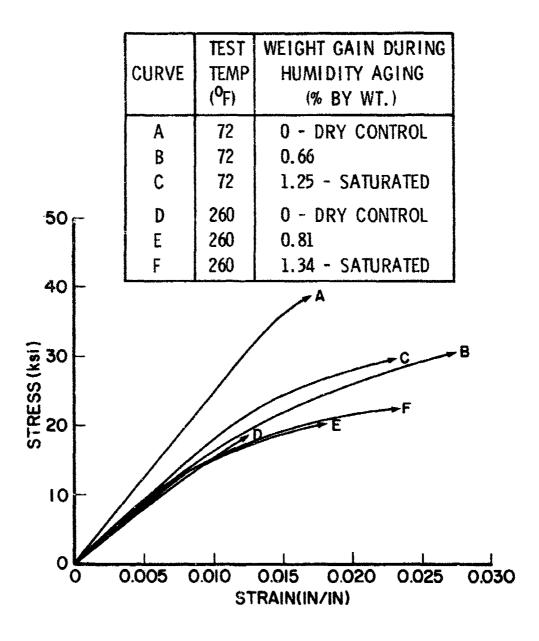


Figure 16. Compressive Stress-Strain Curves for Unidirectional T300/AFR800 Composite Laminates After Humidity Aging at 160°F (71°C) and 100% R.H.: 90° Fiber Orientation.

TABLE 15 CREEP PROPERTIES OF T300/AFR800 COMPOSITE LAMINATES

	Composite H	aterial Properties		
Fiber - T300 Haximum Tempe Resin Content Fiber Content Youd Content	es - T300/AFR800 MATRIX - AFR800 rature Rating - 350°F(177°C) - 27.5% by wt 58.0% by vol 20% by vol. Straight-sided Reference - tension	No. of panels in this table Thickness of e	r 1.59 ickness - 0.0052 from which specime	inch na were tested
		CREEP		
Temperature	Fiber Orientation	0.	\$0 *	±45*
72*F (22*C)	Stress Level [ksi] (MPa) Creep Strain, 500 hr(4) No. of Specimens Residual Strangth(ksi](MPa) No. of Specimens	[163.8] (1129) 0.0067 3 (211.5] (1457) 2	(3.21) (22.1) 4 3 0	[16.27] (112) 0.4039 [23.45] (162) 3
	Stress Level(ksi)(MPa) Creep Etrain, 500 hr(%) No. of Specimens Residual Strength(ksi)(MPa) No. of Specimens	(143.4) (987) 0.0002 3	(2.75) (18.9) 0.0355 2 ² (6.18) (42.6)	[13.94] (96) 0.2693 3
	Stress Level(ksi)(MPa) Creap Strain, 500 hr(%) No. of Specimens Residual Strength(ksi)(MPa) No. of Specimens		(2.29) (15.6) 0.0342 (5.60) (38.6)	[11.62](80) 0.2046 3 [22.97](258)
260°F (127°C)	Stress Level(ksi)(MPa) Creep Strain, 500 hr(%) No. of Specimens Residual Strength(ksi)(MPa) No. of Specimens	(174.5) (1202) 0.1300 at 310 hx. ¹ 1 ² (208.8) (1439)	(2.81) (19.4) 	(13.44) (93) 3 0
	Stress Level[ksi](MPa) Creep Strain, 500 hr(%) No. of Specimens Residual Strength[ksi](MPa) No. of Specimens	[155.1] (1068) 0.0715 2 ² [199.7] (1276)	[2.58] (17.8) 0.0610 3 (5.08] (35.0)	[11.76](81) 1.1214 3 (02.08) (159) 3
	Stress Level[ksi](MPa) Creep Strain, 500 hr(%) No. of Specimens Residual Strength[ksi](MPa) No. of Specimens	(135.7) (935) 0.0054 3 (221.1) (1523) 3	(2.34) (16.1) 0.0608 3 [4.98] (34.3)	(10.08) (70) 0.9367 3 (23.5m) (163) 3
250°F(177°C)	Stress Level(ksi)(MPa) Creep Strain, 500 hr(%) No. of Specimens Residual Strength(ksi)(MPa) No. of Specimens	[156.2] (1076) 0.0646 2 ⁵ [217.1] (1496) 3	[2.71] (18.7) 	(9.76) (67)
	Stress Level[ksi](NPa) Creep Strain, 500 hr(%) No. of Specimens Residual Strength[ksi](NPa) No. of Specimens	[138.8] (956) 0.0142 4 (216.9] (1494) 4	(2.17) (15.0) - 0.2772 ¹ 1 ³ (5.01) - (34.5)	[8.14] (56) 1.7298 at 7 hr. 2 [19.35] (133) 3
	Stress Level[ksi](MPa) Creep Strain, 500 hr(4) No. of Specimens Residual Strength[ksi](MPa) No. of Specimens	[121.5] (837) 0.0494 2: [186.0] (1282) 3	[1.63] (]1.2) 0.3629 3 [3.93] (27.1) 3	[6.51](45) 2.372 at 120 hr 2 ² [16.10] (125)

Notes: All Values represent arithmetic average.

All residual strengths determined by tensile test at 72°F.

Cage malfunctioned before end of test on one specimen.
One specimen failed on loading or during test.
Two specimens failed on loading or during test.
Three specimens failed on loading or during test.
Test owen malfunctioned during test on one specimen.
Strain exceeded gage limits on all specimens.

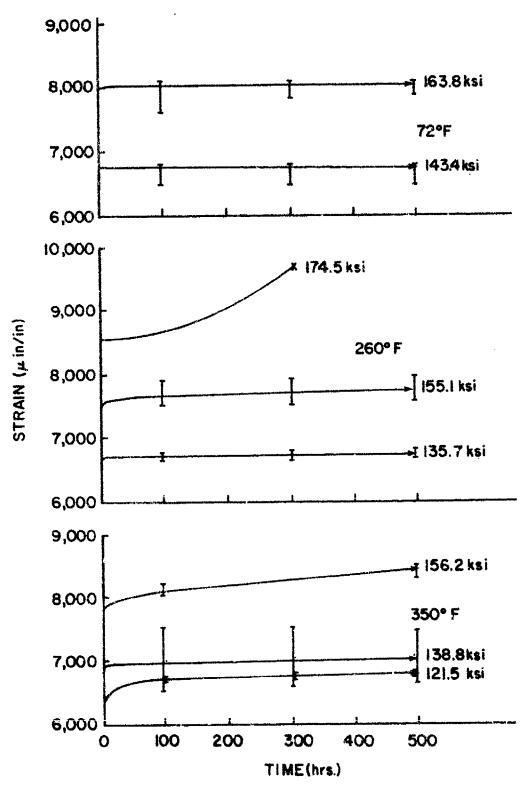


Figure 17. Tensile Creep Behavior of Unidirectional T300/AFR800 Composite Laminates: 0° Fiber Orientation.

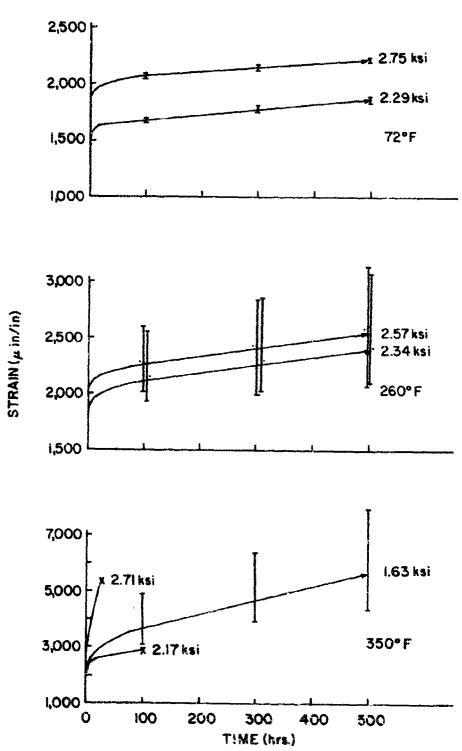


Figure 18. Tensile Creep Behavior of Unidirectional T300/AFR800 Composite Laminates: 90° Fiber Orientation.

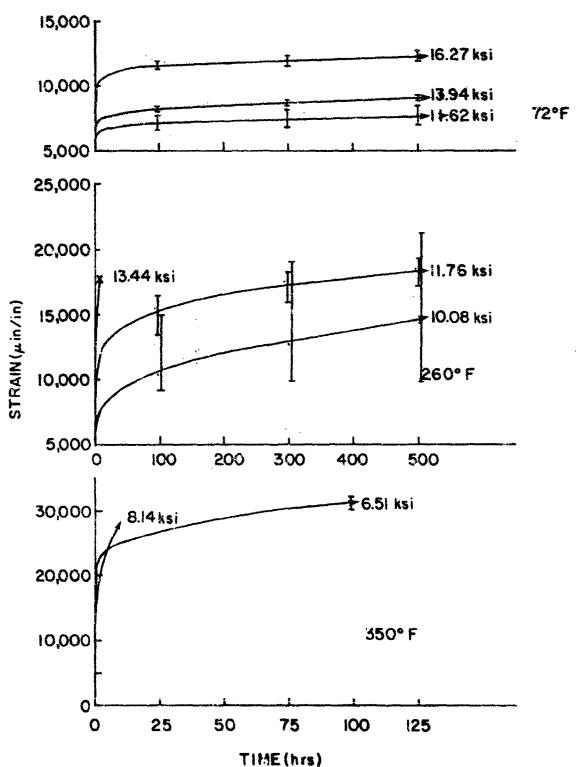


Figure 19. Tensile Creep Behavior of Bidirectional T300/AFR800 Composite Laminates: ±45° Fiber Orientation.

TABLE 16

STRESS RUPTURE PROPERTIES OF T300/AFR800 COMPOSITE LAMINATES

Composite Material Properties						
Material System - T300/AFR800 Prepreg by - Hexcel Graphite/Epox Fiber - T300 Matrix-AFR800 Maximum Temperature Rating - 350°P Resin Content - 27.5% by wt. Fiber Content - 68.0% by vol. Void Content - 68.0% by vol. Test Method - Straight-sided Reference - ASTM D2290 & 0° - 6 ply tension D3039 90° - 15 ply +45° - 8 ply						
	ST	RESS RUPTURE				
Temperature	Fiber Orientation	0.	90°	+45*		
72*F(22*C)	Stress Level[ksi](MPa) Time to Failure(hrs) No. of Specimens Residual Strength[ksi](MPa) No. of Specimens Stress Level[ksi](MPa) Time to Failure(hrs) No. of Specimens Residual Strength[ksi](MPa) No. of Specimens	[163.8] [1129) 500 3 [211.5] (1457) 2 [143.4] (987) 500 3	(2.75) (18 333 3 (6.18) (42 2 (2.29) (15 500 ¹ 3 (5.60) (38	500° 3 (23.45) (162) 3 (13.94) (96) 500°		
260°F(127°C)	Stress Level[ksi](MPa) Time to Failure(hrs) No. of Specimens Residual Strength[ksi](MPa) No. of Specimens Stress Level[ksi](MPa) Time to Failure(hrs) No. of Specimens Residual Strength[ksi](MPa) No. of Specimens	(174.5) (1202) 167 ³ 3 (208.8) (1439) 1 (155.1) (1068) 336 ² 3 (199.7) (1376)	[2.81] (19 1673 3 [6.11] (42 1 [2.58] (17 5001 3 [5.08] (35	.8) (11.76) (81) 500 ¹		
350°F (177°C)	Stress Level[ksi] (MPa) Time to Failure(hrs) No. of Specimens Residual Strength[ksi] (MPa) No. of Specimens Stress Level[ksi] (MPa) Time to Failure(hrs) No. of Specimens Residual Strength[ksi] (MPa) No. of Specimens	(156.2) (1076) 500 ¹ 3 (217.1) (1496) 3 (138.8) (956) 500 ¹ 4 (216.9) (1494)	[2.71] (18 23 3 0 [2.17] (15 235 3 [5.01] (34	.0) [8.14] (56) 500 3		

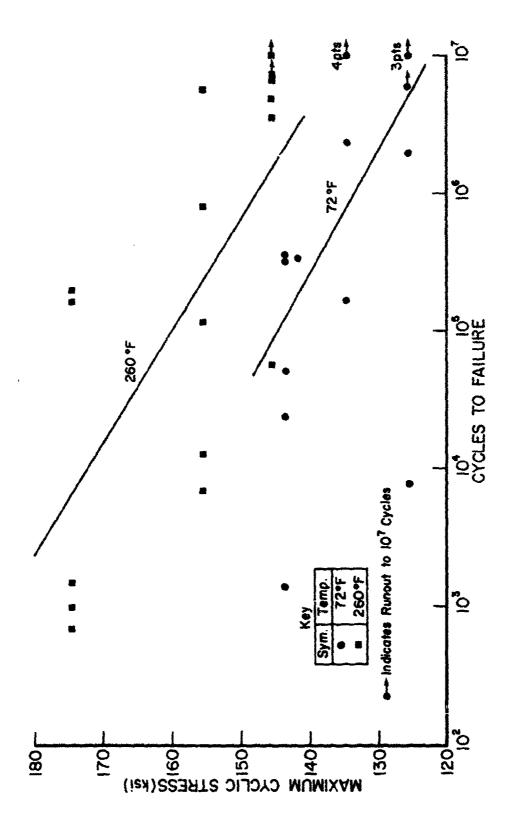
Notes: All values represent arithmetic averages. All residual strengths_determined by tensile test at 72°F (22°C).

1. No failures within 500 hours.

- Average of one failure and two 500-hour survivals.
- Average of two failures and one 500-hour survival.
- 4. Average of three failures.

TABLE 17 FATIGUE PROPERTIES OF T300/AFR800 COMPOSITE LAMINATES

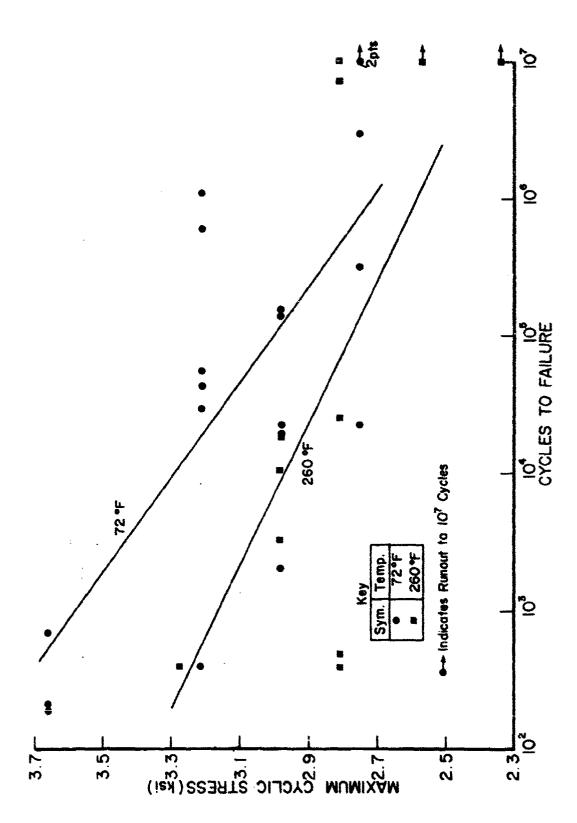
	Composite M	aterial Properties				
Fiber - T300 Maximum Tempo Resin Content Fiber Content Void Content	tem - T300/AFR800 Matrix - AFR800 Erature Rating - 350°F(177°C) t - 26.9% by wt. t - 68.6% by vol ± 0% by vol Straight-sided Reference - tension	No. of panels from which specimens were tested in this table - 25 Thickness of each type specimen:				
	TENSILE	FATIGUE, R=0.1	-			
Temperature	Fiber Orientation	0.	90*		<u>+4</u> 5°	
72*F(22*C)	Max. Stress[ksi](MPa) Lifetime (cycles) No. of Specimens Residual Strength[ksi](MPa) No. of Specimens	[143.7] (990) 45,336 5 0	[3.21] (2 52,038 6 		(16.27) (112) 17,688 5 	
	Max. Stress[ksi](MPa) Lifetime (cycles) No. of Specimens Residual Strength[ksi](MPa) No. of Specimens	[134.7] (928) 3,960,636 6 [211.0] (1454)	[2.98] (3 29.093 5 0		(15.11) (104) 47,600 5 0	
	Max. Stress[ksi](MPa) Lifetime (cycles) No. of Specimens Residual Strength[ksi](MPa) No. of Specimens	{125.7} (866) 2,124,065 6 {203.3} (1401) 3	[2.75] () 1,164, 5 [5.49] () 2	422	[13.94) (96) 1,403,780 5 0	
260°F{127°C}	Max. Stress[ksi](MPa) Lifetime (cycles) No. of Specimens Residual Strength[ksi](MPa) No. of Specimens	[174.5] (1202) 8,052 5 	[2.98] (8723 3 0		[12.60] (87) 84,080 5 ———	
	Max. Stress[ksi](MPa) Lifetime (cycles) No. of Specimens Residual Strength[ksi](MPa) No. of Specimens	(155.1] (1069) 136,078 5 	[2.81] (51,60 5 [7.28] (8	[11.76] (81) 68,513 5 	
	Max. Stress[ksi](MPa) Lifetime (cycles) No. of Specimens Residual Strength[ksi](MPa) No. of Specimens	[145.4] (1002) 1,759,820 4 [187.6] (1292)	[2.57] 7(10 ⁴ 1 [6.10] (+	[10.92] (75) 3,449,829 5 [21.20] (146)	



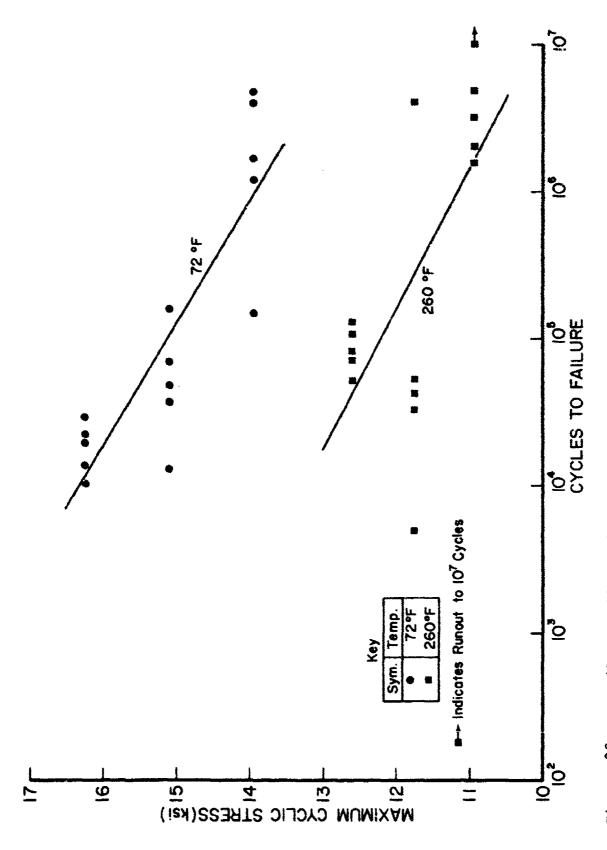
| 「一般の一般のでは、ないないできない。 しょうかんかんかんかいない しゃく かんかん しゅうしゅ しゅうかい かいこう

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Tensile-Tensile Fatigue Behavior of Unidirectional 1300/AFR800 Composite Laminates: 0° Fiber Orientation, R=0.10, 10 Hz. Figure 20.



Tensile-Tensile Fatigue Behavior of Unidirectional T300/AFR800 Composite Laminates: 90° Fiber Orientation, R = 0.10, 10 Hz. Figure 21.



Tensile-Tensile Fatigue Behavior of Bidirectional T300/AFR800 Composite Laminates: +45° Fiber Orientation, R = 0.10, 10 Hz. Figure 22.

TABLE 18
THERMOPHYSICAL PROPERTIES OF T300/AFR800
COMPOSITE LAMINATES

	Compos	ite Katerial	Properties		
External System - T300/At Fiber - T300 Exatrin Haximum Temperature Rating Resin Content - 26.74 by Fiber Content - 6.54 by Void Content - 6 04 by v Thickness of each type spe	:- AFR 800 ;- 350°F(17 Vt. vol. ol. cimen: Ther	7°C) Lami Aver No.	this table - ply S	-1.59 ness - 0.00 m which sp 2 pec. Ht	ecimens were tested
	THEFMOP	HYSICAL PROPE	RTIES: 0*		
	-67°F(-55°C)	72°F(22°C)	260°F (127°C	350°F (177	Test Method
Thermal Expansion ¹ a _X [µin/in-*F] (µcm/cm-*C) a _y [µin/in-*F] (µcm/cm-*C) No. of Specimens per direction	-0.08 12-9 3	-0.37 13.6 3	-0.14 14.5 3	-0.20 16.9 3	Tota ²
Specific Heat Cp[btu/lb*F](J/kg-*C) No. of Specimens	[0.081] (339) 3	[0.203](849) 3	[0.302](1263) 3	[0.308] (12 3	DSC ³
Thermal Conductivity ¹ k _z [btu-ft/ft ² -hr-*F] (W/m-*C) No. of Specimens	[D.371] (0.642) 3	to .433) (0.749) 3	b.517 } b.894)	[0.555] (0.960) 3	Comparative
Glass Transition Temp. Dry [*F](*C) Wet [*F](*C)	[468] (242) [381] (194)				DHA ⁴ DHA
	THERMOP	YSICAL PROPE	RTIES: +45°		
Thermal Expansion 1 \$\alpha_{\pi}[\pi\in-\frac{\pi}{\pi}] (\pi\cm-\chi-\chi)\$ No. of Specimens per direction	2.6	2.4	2.8	3.2	THA ²
Thermal Conductivity ¹ k _z [btu-ft/ft ² -hr-*F] (W/m-*C) No. of Specimens	[0.311] (0.538) 3	[0.351] (0.607) 3	[0.406] (0.702) 3	[0.433] (0.749) 3	بيدوني بخسا

- NOTES:1. On the unidirectionally reinforced specimens, the x-direction is along the fiber axis, the y-direction is across the fiber axis, and the x-direction is through the thickness (identical to the y-direction). On ±45° bidirectionally reinforced specimens, the x and y directions are identical and oriented at 45° to either fiber direction, while the x-direction is through the thickness.
 - 2. Thermo-Mechanical Analysis.
 - 3. Differential Scanning Calorimetry.
 - 4. Dynamic Hechanical Analysis.

4.2 sic/5506

This system consisted of 5.6 mil (0.14 mm) silicon carbide fiber (on a carbon core) in an epoxy matrix resin. Both the fiber and resin were AVCO products (Specialty Materials Division, Lowell, Massachusetts). The resin is a 350°F (177°C) curing system which is modified for extra toughness.

Tables 19 through 32 present the data generated for this silicon carbide-epoxy system. Figures 23 through 40 illustrate the stress-strain, fatigue, and creep behavior of this material, as well as the effects of humidity aging upon selected composite properties.

Perhaps the most obvious feature of this system is the substantial decrease in property levels, particularly the resin dominated properties, at the 350°F (177°C) test temperature relative to the 260°F (127°C) test temperature.

The high 0° compressive properties exhibited by this system relative to the other systems tested reflect the beneficial effect of the much larger filament diameter compared to graphite in resisting buckling.

PROCESSING CONDITIONS FOR SIC/5506 COMPOSITE LAMINATES

Composite Processing Information

Material System - SiC/5506

Fiber - 5.6mil SiC

EMPACATE A MERCETA WHAT WAS A WAY

Matrix - AVCO 5506

Maximum Rated Temperature - 350°F

SiC/Epoxy

Prepreg by - AVCO

Laminate Processing Schedule

Layup Procedure: The prepreg was stored in a closed wrapper at 0°F (-18°C). Prepreg was warmed to room temperature before removal from wrapper to prevent moisture condensation on pregreg. Plies were cut to desired size with razor knife and stacked in desired sequence (release paper removed from each ply). The stack was placed in the autoclave according to the layup system illustrated in Figure 23. The corprene edge dam serves to restrict fiber flow.

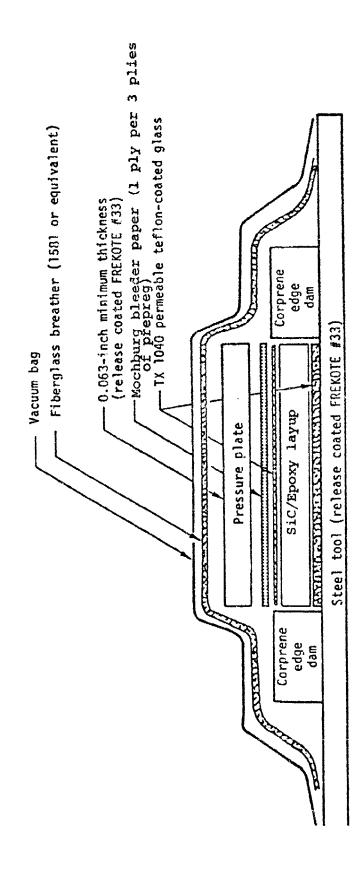
Cure Schedule: Apply full vacuum and hold it throughout the cure cycle. Pressurize to 85 psi above bladder and heat at 4-6°F/min to 350°F. Hold at 350°F for 1 1/2 hours. Cool under pressure and vent vacuum.

Postcure Schedule: After trimming of flash, panels were placed, unrestrained in a circulating air oven and heated to 375°F at 4-6°F/min. They were held at 375°F for four hours then cooled to room temperature.

NOTE: This cure schedule represents one which differs from that originally recommended by AVCO. Due to the slower response of the large autoclave used to fabricate our panels, the cure schedule had to be modified. The original schedule recommended by AVCO was as follows:

Apply full vacuum. Pressurize to 50 psi above bladder and heat at 4-6°F/min to 350°F, venting vacuum when temperature reaches 135°F. Hold at 350°F for 1-1/2 hours and cool under pressure.

This cure schedule, when followed in our autoclave, produced laminates having a specific gravity of 2.19 and void content of 5.7%.



The second second second

Figure 23. Layup System for SiC/5506 Laminates.

TABLE 20
PREPREG AND COMPOSITE PHYSICAL PROPERTIES

Composite Pi Material System - SiC/5506 Fiber - 5.6 mil SiC Maximum Rated Temperature -	Matrix - A	v∞ 5506	SiC/Epoxy	
Prepre	g Physical	Properties		······································
(Property)	(Stnd.Dev.)	(Range)	(Test Method)	(Ref.)
Volatile Content-1.40% Resin Content-27.9% Resin Flow- No. of Rolls Involved-4 No. of Batches Involved-1			Advanced Para Composite Design Guide	
Laminat	e Physical	Properties		
No. of Panels-31 Fiber Content-58.6% by vol. Resin Content-19.0% by wt.	1.3%	53.9-61.2%	(Test Method) Acid Digestion AFML-TR-67-243	
Void Content- 0.7% by vol. Laminate Sp. Gr 2.36	0.7%		D2734	ASTM ASTM
	As re	ported by ma	nufacturer.	
Thickness per ply-0.0064 in.	0.0002 in.	0.0061-0.006	9 in:	

The properties reported here represent averages for all panels of this material used throughout the program.

Pregreg also contains a glass scrim cloth (4.5% by wt.) with a fiber specific gravity of 2.40.

HPLC ANALYSIS

SAMPLE (CONC.) AVC.	506 SAMPLE SIZE WAVM	,
	TRILE MORILE PHASE 2 WATER	•
FLOW RATE 2-0 M/m	PROGRAM METH. O	•
COLUMN(S) 62S	DETECTOR TRACOR 970	
CHART SPEED 0.5	MAVE LENGTH 230 nm	•
DATE MOVEMBER 29	6 79 OPERATOR WOLFE	•
TIME O	WATER 76% ACETO.	24%
20 MN	18 %	827.
21 MIN	1%	99%

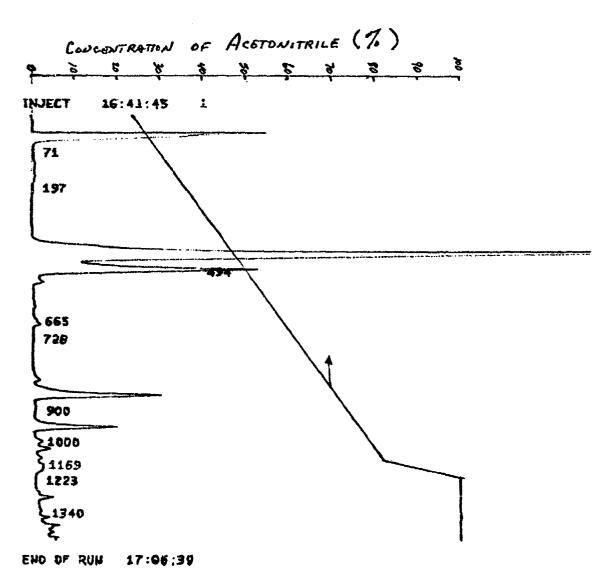


Figure 24. HPLC Analysis of AVCO 5506 Epoxy Resin.

HPLC ANALYSIS

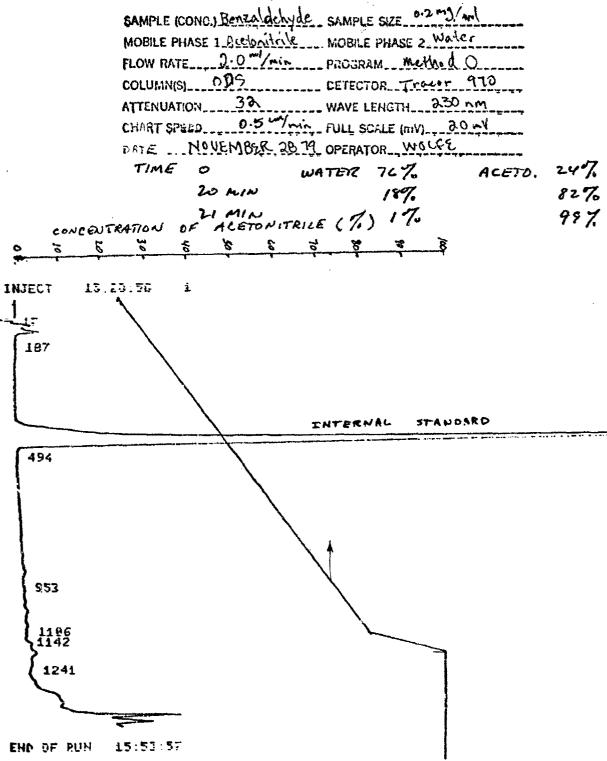


Figure 25. HPLC Analysis of Benzaldehyde.

HPLC ANALYSIS SAMPLE (CONC.) EPON 828 SAMPLE SIZE 1.5 mg/ml. MOBILE PHASE 1 ACCTONICITY MOBILE PHASE 2 WILLEY FLOW RATE 20 m2/min PROGRAM METH O COLUMNIS) 905 DETECTOR Tracer 970 ATTENUATION 32 WAVE LENGTH 230 NM CHART SPEED 1.5 MALE FULL SCALE (INV) 20mV DATE DEC 3 79 OPERATOR WOLFE CONCENTRATION OF ACETONITRILE (%) Typical Epoxy 91 155 259 1255

Figure 26. HPLC Analysis of Epon 828 Epoxy Resin.

F 1363

18:15:56

END OF RUH

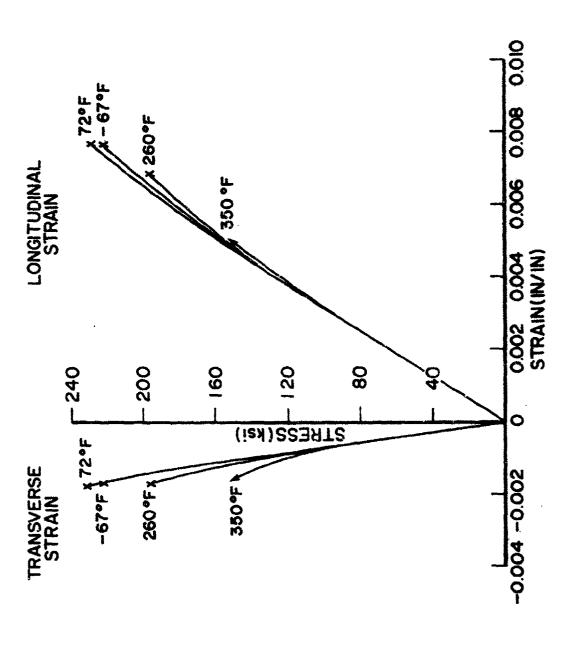
TABLE 21 TENSILE PROPERTIES OF SIC/5506 COMPOSITE LAMINATES

	Composite	Material Propertie	28	
Haterial System - SiC/5506 Fiber - 5.6 mil SiC Hatrix - AVCO S506 Haximum Rated Temperature - 350°F(177°C) Resin Content - 18.8° by wt. Fiber Content - 59.9° by wol. Void Content - 0.3° by vol. Thickness of each type specimen: 0° - 6 ply Prepreg by - AVCO SiC/Epoxy Laminata Sp. Gr 2.38 Hominal Ply Thickness - 0.0062 inch No. of panels from which specimens were tested in this table - 6 in this table - 6 ; 90° - 15 ply				
		PENSION: 0"		
	-67*P(-55*C)	72 F(22 C)	260 P() 27 C)	350°F(177°C)
F _X [ksi](NPa)	[221.6] (1527)	[229.1] (1578)	[190.6] (1313)	[174.5] (1202)
Stnd.Dev.(kmi)(HPa) Range (kmi)(HPa)	[18.2] (125) [198.8 - 235.8] (1370 - 1625)	[8.4] (58) [220_3 - 241.7] [1518 - 1665]	[13.3] (92) [178.8 - 205.0] [1232 - 1412)	[11.0] (76) [161.7 - 181.0] [1114 - 1247)
No. of Specimens	5	3	31	3-
P ^{tpl} [ksi] (1994)	[129.5] (892)	[71.4] (492)	[86-7] (59)	[57.4] (395)
Stnd.Dev.[kei](HPa) No. of Specimens	(36-2) (249) 5	[20-4] (141) ' 5	(12.5) (86) 3	[19-5] (134) 3
E _X [Mai](GPa)	[32.3] (223)	[33.4] (230)	[33.2] (229)	[33.0] (227)
Stnd.Dev.[Msi](GP&) No. of Specimens	(1.1) (7.6) S	(1.3) -(9.0) S	(0.4) (2.8) 3	[2.4] (1.7) 3
ε _x (μin/in)(μcm/cm)	7600	7660	6800	5130,+ ²
Stnd.Dav. No. of Specimens	190 5	760 5	2	N.A. 3
ν _{xy}	0.22	9.23	0.25	0.32
Stnd. Dev. No. of Specimens	0.03 5	0.02 4	0.05 3	0.15
Test Nethod Reference		AST	M D3Q39	
		Tension: 90°		
F ^{tu} [ksi](10a)	[9.78] (67.4)	(9.71] (66.9)	[6.44] (44.4)	[4.34] (29.9)
Stnd.Dev.[ksi](MPa) Range	[1.42] (9.78) [8.31 - 11.55] (57.3 - 79.6)	[0.51] (3.5) [8.99 - 10.43] (61.9 - 71.9)	[0.10] (0.7) [6.34 ~ 6.56] (43.7 ~ 45.2)	[0.40] (2.8) [3.84 - 4.92] (26.5 - 33.9)
No. of Specimens	5	\$.	5	5
rtpl (ksi](MPa) Stnd.Dev.[ksi](MPa) No, of Specimens	[6.17] (42.5) [1.21] (0.3) 5	[4.2A] (29.2) [0.62] (4.3) 5	[2.84] (19.6) [0.17] (1.2) 5	(1.75) (12.1) (0.13) (0.9) 5
Ey (Msi') (GPa) Stnd. Dev. (Msi) (GPa)	{3.86} (26.6) [0.12] (0.83)	(2.99) (20.6)	[1.97] (13.6) [0.16] (1.1)	(1.04) (7.2) [0.13] (0.9)
No. of Specimens	5	3	5	5
ε ^{tu} [µin√in](µcn√cm)	2,748	3,727	4,695	7,550
Stnd. Dev. No. of Specimens	470 5	194 5	373 5	975 5
Vyx Stnd. Dev.	a.o25 ³	0.0213	0.015 ³	0.0103
No. of Specimens	ļ '	1		1

lexicludes data from two specimens from bad panel (had very high wold content).

Strain gages failed before end of test on two of three specimens.

Computed using elastic would and longitudinal Poisson's ratio.



Tensile Stress-Strain Curves for Unidirectional SiC/5506 Composite Laminates: 0° Fiber Orientation. Figure 27.

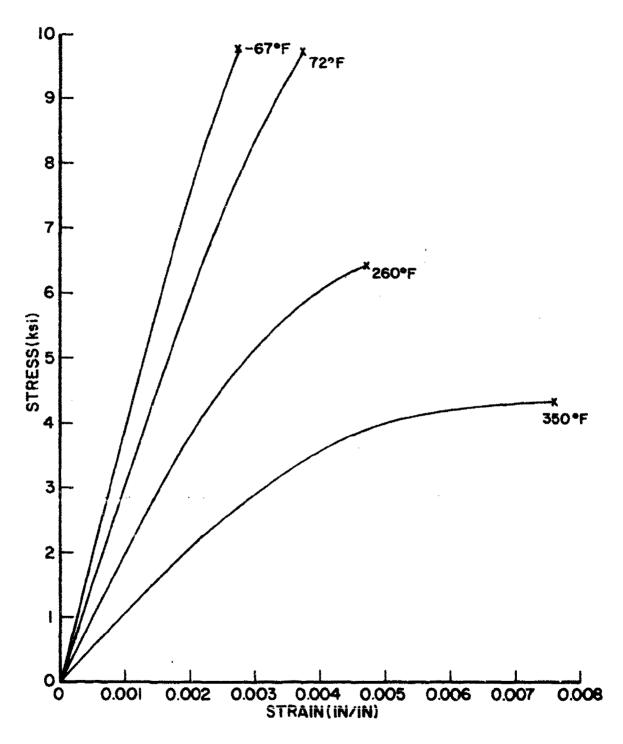
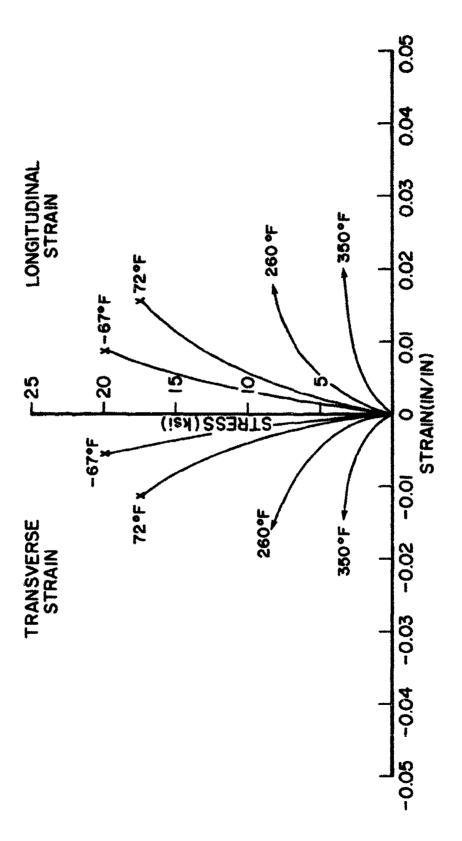


Figure 28. Tensile Stress-Strain Curves for Unidirectional SiC/5506 Composite Laminates: 90° Fiber Orientation.

TABLE 22
TENSILE PROPERTIES OF SiC/5506
COMPOSITE LAMINATES

		Material Propert			
Material System - Sic, Piber - 5.6 mil Sic Maximum Rated Temperat Resin Content - 20.2% Piber Content - 56.8% Void Content - 0.7% b	Matrix - AVCO 5506 ure - 350°F(177°C) by wt. by vol.	Prepreg by - AVCO SiC/Epoxy Laminate Sp. Gr 2.33 Nominal Ply Thickness - 0.0064 inch No. of panels from which specimens were tested in this table · 4 Thickness of specimen - 8 ply			
	T	NSION: +45*			
	-67°F(-55°C)	72°F (22°C)	260°F (127°C)	350°F (177°C)	
P ^{tu} (ksi)(MPa)	[19.72] (135.9)	[17.32] (119)	[11.52] (79)	[7.93] (54.6)	
Stnd.Dev.[ksi](MPa) Range [ksi](MPa)	[1.19] (8.2) [17.69 - 20.63] (121.9 - 142.1)	[0.58] (4.0) [16.52-17.95] (114 - 124)	[0.34] (5.8) [10.66~12.45] (79 - 99)	[0.18] (1.2) [7.67 - 8.17] (52.8 - 56.3)	
No. of Specimens	5	5	5	5	
F _x [ksi] (MPa)	[6.25] (43.1)	[5.14] (35)	(1.59) (11)	[0.93] (6.4)	
Stnd.Dev. [ksi] (MPa) No. of Specimens	{0.57] (3.9) 5	[0.92] (6.3) 5	[0.37] (2.5) 5	[0.32] (2.2)	
E ^t [Msi](GPa)	[3.71] (25.6)	[2.97] (20)	[1.63] (11)	[0.51] (3.5)	
Stnd.Dev.[Msi](GPa) No. of Specimens	[0.22] (1.5) 5	[0.30] (2.1) 5	[0.27] (1.9)	(0.19) (1.3) 5	
ε ^{tu} [μin/in] (μcm/cm)	8,600	15,510	35,100+1	30,900+1	
Stnd. Dev. No. of Specimens	1,234 5	544 5	7,280 5	6,540 5	
v _{xy}	0.66	0.74	0.89	0.74	
Stnd. Dev.	0-07	6.08	0.11	0.11	
No. of Specimens	5	5	5	5	
Test Method Reference	ASTM D3039				

¹Ultimate strain exceeded limits of strain gages.



Tensile Stress-Strain Curves for Bidirectional SiC/5506 Composite Laminates: +45° Fiber Orientation. Figure 29.

TABLE 23

TENSILE PROPERTIES OF SIC/5506 COMPOSITE LAMINATES

COmposite Naterial Properties						
Raterial System - SiC/5506 Fibrs - 5.6 mil SiC Matrix - AVCO 5506 Faxisum Rated Temperature - 350°F(177°C) Frish Content - 18.9t by wt. Fibrs Content - 58.66 by vol. Wold Content - 0.9% by vol. Thickness of each type specimen: 20 ply Prepreg Ly - AVCO SiC/Epoxy Laminate Sp. Gr 2.35 Nominal Ply Thickness - 0.0062 inch No of panels from which specimens were tested in this table - 8						
TERSION: (0, +45, -45, 0, 0, -45, +45, 0, 90, 0) ₄						
4	-67°F(-55°C)	72°F (22°C)	260°F (127°C)	350°P(177°C)		
fu (ksi)(MPa) Stnd.Dev.(ksi)(MPa) Range (ksi)(MPa) No. of Specimens		1119.3] (822) [8.2] (56) [108.2 - 125.6] (745 - 865)	[117.2] (807) [7.7] (53) [107.4-126.2] (740 - 870) 5	[107-2] (739) [6.0] (41) [102.1-115-6] (703 - 796)		
F ^{tpl} [kai] (MPa)		(38.6) (266)	[49.1] (338)	(60.3) (415)		
F. [ksi] (HPa) Stnd.Dev.[ksi] (HPa) No. of Specimens		(18.8) (130) 5	[15.0] (103) 5	(11.1) (76) 4		
E, [Mai](GPa)		[20.5] (141)	[19.0] (131)	[18.1] (125)		
Stnd.Dev.[Hei](GPa) No. of Specimens		[2.0] (14) 5	[0.4] (2.8) S	(0.6) (4) 4		
tu [pin/in](pcm/cm)		5725	5740	5190		
Stnd.Dev. No. of Specimens		100 4	100 5	670 4		
ν ^t γ _{xy}		0.31	0.45	0.40		
Sind. Dev. No. of Specimens		0.10 4	0.11 5	0.06		
Test Method Reference ASTM 03039						
TENSION: (0, +45, -45, 0, 0, -45, +45, 0, 90, 0) with hole 1						
ry (kmi) (NG-m)		[102-5] (706)	***************************************			
Sind.Dev. [ksi] (NPa) Range		(3.5) (24) (97.6-105.8) (672 - 729)				
No. of Specimens		š				
ry (ksi)(MPa) Stnd.Dev.[ksi](MPa) Ko. of Specimens						
Ey [Msi] (GPa) Stud.Dev.[Msi] (GPa) Ro. of Specimens			Variable distribution from the con-			
fu [pin/in] (pem/cm) find. Dov. Ko. of Specimens			The state of the s			
vyx Stud. Dov. ES. of Specimens		dees symptometers	de de cidade de composições de compo			
Test Mithod Reference ASTM 00039						

These specimens had a 0.1915 inch (0.491 cm) hole in the center of the test section. Stresses were calculated using ne', cross-sectional area.

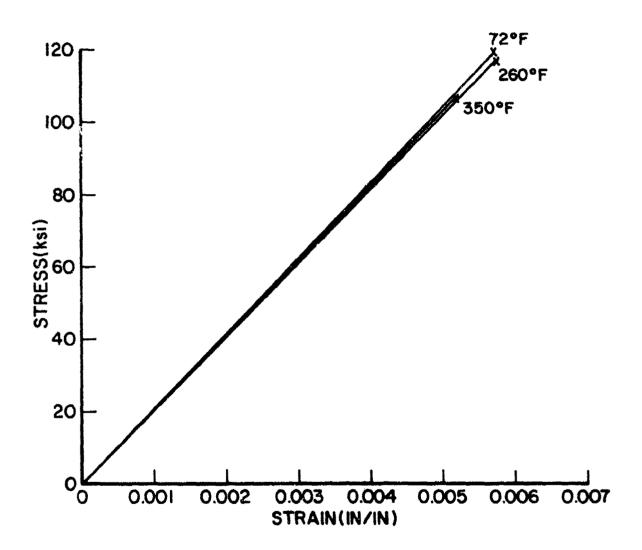


Figure 30. Tensile Stress-Strain Curves for Multidirectional SiC/5506 Composite Laminates: (0,45,-45,0,0,-45,45,0,90,0)_s Fiber Orientation.

TABLE 24
COMPRESSIVE PROPERTIES OF SiC/5506
COMPOSITE LAMINATES

	Composite	Material Propertie	35	
Material System - SiC/ Fiber - 5.6 mil SiC Maximum Rated Temperatu Resin Content - 18.5% Fiber Content - 59.7% Void Content - 0.1% Thickness of each type	Matrix - AVCO 5506 ire - 350°F(177°C) by wt. by vol. by vol.	No. of panels in this tabl	Gr 2.38 Thickness - 0.0061 s from which speciale - 1	
	COM	PRESSION: 0*		
	-67°F(-55°C)	72°F(22°C)	260°F(127°C)	350°F(177°C)
F ^{CU} [ksi] (MPa) Stnd.Dev. [ksi] (MPa)	[391] (2694) [36] (248)	[326] (2246) [20] (138)	[232] (1598) [8] (55;	[131] (903) [29] (200)
Range [ksi] (MPa) No. of Specimens	[335 - 435] (2308 - 2997) 5	(305 - 350) (2101 - 2412)	[221 - 240] (1523 - 1654)	[97 - 154] (668 - 1061)
FCPl [ksi](MPa)	(239) (1647)	[117] (806)	[141] (1269)	[95] (655)
Stnd.Dev. (ksi] (MPa) No. of Specimens	(65) (448) S	[61] (420) 3	{ 32] (220) 5	(9) (62) 5
E ^C [Msi](GPa)	[33.1] (228)	[35.5] (245)	[33.9] (233)	[34.0] (234)
x Stnd.Dev.[Msi](GPa) No. of Specimens	[3.0] (21)	[2-8] (19) S	[3.2] (22) 5	{ 8.0} (55) · S
ε u [μin/in] (μcm/cm)	12,920+122	6,220+ ³	7,760	3,560+1,2
Stnd. Dev. No. of Specimens	4,310	1,730 5	1,110	300 5
Test Method Reference	ASTM D3410			
	CO	PRESSION: 90°		
Fy [ksi] (MPa)	[56.7] (391)	[34.4] (237)	[25.7] (177)	[19.8] (136)
Stnd.Dev.(ksi](MPa) Range	[3.6] (25) [53.4-62.3] (368-429)	[1.7] (12) [31.8-36.3] (219-250)	(1.5) (10) (23.0-26.9) (158-185)	[1.2] (8) [18.7-21.6] (129-149)
No. of Specimens	5	5	5	5
rcpl [ksi](MPa) Y Stnd.Dev.[ksi](MPa) No. of Specimens	[15.5] (107) [7.1] (49) 5	[9.1] (63)	[14.3] (99) [3.2] (22) 5	[9.4] (65) [2.2] (15) 5
E _v [Msi](GPa)	[3.41] (23.5)	(3.58) (24.7)	[2.40] (16.5)	(1.88) (13.0)
Stnd. Dev. [Msi] (GPa) No. of Specimens	[0.97] (6.7) 5	(0.60) (4.1) 5	[0.12] (0.8) 5	[0.32] (2.2)
Ey [µin/in](µcm/cm)	22,200	9,240+	20,540+1,2	27,100
Stnd. Dev. No. of Specimens	3,340 5	4,820 5	3,620 5	3,070
Test Method Reference		AST	M D3410	

Ultimate strain values represent miximum cheerved strain rather than ultimate values.

²Two of five specimens exhibited evidence of buckling.

Tabs debonded during first test attempt at about 65% of ultimate strength. Tabs were rebonded with a different adhesive and the tests were rerun. Modulus and proportional limit were obtained from data recorded during first test. Ultimate strain values could not be obtained during second test because of strain gage damage when first set of tabs dabonded. Value reported represents strain when tabs debonded on first test.

[&]quot;Three of five specimens exhibited evidence of buckling.

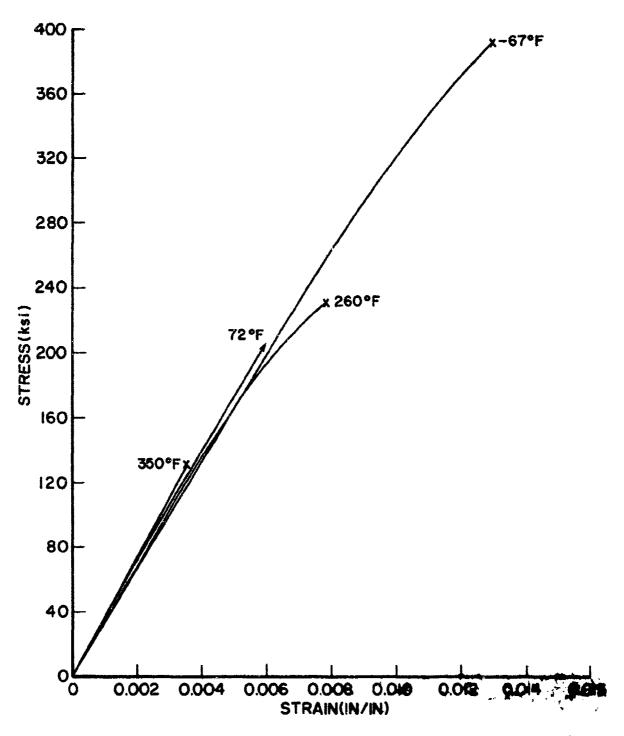


Figure 31. Compressive Stress-Strain Curves for Undirectional SiC/5506 Composite Laminates: 0° Fiber Orientation.

THE SAME SAME PROPERTY.

Figure 32. Compressive Stress-Strain Curves for Unidirectional sic/5506 Composite Laminates: 90° Fiber Orientation.

TABLE 25
FLEXURAL PROPERTIES OF SiC/5506
COMPOSITE LAMINATES

	Composite	Material Properti	cs	
Material System - Sic Piber - 5.6mil Sic Maximum Rated Temperat Resin Content - 19.4% Fiber Content - 58.9% Void Content - ± 0% Thickness of each type	Matrix - AVCO 5506 Aure - 350°F(177°C) by wt. by vol. by vol.	No. of panel in this tak	Gr 2.37 Thickness - 0.0069 s from which specimole - 2	inch tested
	1	FLEXURE: 0°		
	-67°F(-55°C)	72°F (22°C)	260°F (127°C)	350°F (177°C)
rfu [ksi] (MPa) Stnd.Dev. [ksi] (MPa) Range [ksi] (MPa)	[324.9] (2239) [8.1] (56) [317.9-336.4]	[314.6] (2168) [10.1] (69.6) [298.0-324.1]	[189.3] (1304) ^{1,2} [21.6] (148) [166.1-217.2]	[6.5] (45) [109.9-126.2]
No. of Specimens	(2190-2318)	(2053-2233)	(1144-1497)	(757 ~870) 5
Ef [Msi] (GPa'	[31.9] (220)	[31.8] (219)	[29.6] (204)	[30.4] (209)
Stnd.Dev.[Msi](GPa) No. of Specimens	[0.71] (4.9)	[0.48] (3.3) 5	[0.94] (6.5) 5	[1.8] (12) 5
Test Method Reference	4 pt. flexure Design Guide; Jan	Corresp 1. 1971 loading	onds to ASTM D790 e points and loading	xcept for speed
		FLEXURE: 90°		
Ffu [ksi](MPa) Stnd.Dev.[ksi](MPa) Range [ksi](MPa) No. of Specimens	[15.86] (109) [1.3] (8.9) [14.94-17.26] (103-119) 5	[14.53] (100) [0.78] (5.4) [13.45-15.53] (93-107) 5	[11.08] (76) [1.35] (9.3) [9.96-13.21] (69-91) 5	[6.96] (48) ² [0.63] (4.3) [6.09-7.74] (42-53)
E (Mai) (CPc)	(2.71) (19)	[2.34] (16)	[1.44] (9.9)	[0.85] (5.9)
Stnd.Dev.[Msi](GPa) No. of Specimens	[0.18] (1.2) 5	[0,13] (0.9) 5	[0.18] (1.2)	[0.03] (0.2) 5
Test Method Reference	4 pt. flexure Design Guide; Ja	n. 1971 } Correspo	onds to ASTM D790 ex points and loading	cept for speed

Specimens underwent abnormally large deformations and exhibited interlaminar shear failure rather than tensile failure on bottom ply.

²See following table for flexure properties using a three-point loading mode.

TABLE 26

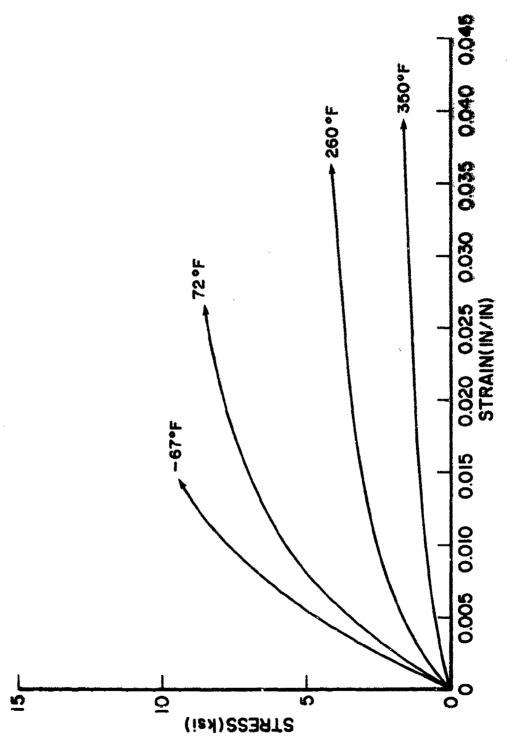
FLEXURAL PROPERTIES OF SiC/5506 COMPOSITE LAMINATES

	Composite	Material Propert	ies		
Material System - SiC/ Fiber - 5.6 mil SiCkatr Maximum Rated Temperat Resin Content - 17.4% Fiber Content - 61.1% Void Content - 0.5% Thickness of each type	ix - AVCO 5506 ure - 350°F by wt. by vol. by vol.	in this tak	Gr 2.4 Thickness of the from which the - 1	0.0061	inch
		PLEXURE: 0°			
	-67°F(-55°C)	72°F(22°C)	260°F (12	7°C)	350°F (177°C)
Ffu [ksi] (MPa) Stnd.Dev.[ksi] (MPa) Range [ksi] (MPa) No. of Specimens Ef [Msi] (GPa) Stnd.Dev.[Msi] (GPa) No. of Specimens Test Method Reference		ASTM D790, Method	[316.7] [7.2] [308.7-32 (2127-22 4 [29,0] [0.9] 4 1 (3 pt, f)	(49) 22.9] 22.9] (25) (200)	[175.5] (1209 [5.4] (37) [173.8-182.9] (1197-1260) 4 [24,6] (169) [0,8] (6)
		FLEXURE: 90°			
Ffu [ksi](MPa) Stnd.Dev.[ksi](MPa) Range [ksi](MPa) No. of Specimens Ef [Msi](GPa) Stnd.Dev.[Msi](GPa) No. of Specimens					[9,89] (68) [1.51] (10) [8,20-11.30] (56-78) 4 [1.03] (7.1) [0.11] (0.8)
Test Method Reference	۸	STM D790, Method 1	. (3 pt. fle	xure)	•

¹ Specimens failed by interlaminar shear rather than tensile failure on bottom ply.

TABLE 27
SHEAR PROPERTIES OF SIC/5506
COMPOSITE LAMBAGES

	Composit	Material Propert	ies	
Motorial System — Sic Filter — S.6 mil Bic Maximum Bathed Temperat Sesin Content — 18-35 Filter Content — 60-14 Weid Content — — 0 Thickmans of each type	Matrix - 3000 5500 ture - 350°F(1777°C) by wt. by vol.	Lautinate Sp Sentinal Ply Sp. of pane in this tal	. Gr 2.33 Thickness - 9.000 In fame which spec ble - 4	
	I	WPLANE SHEAR	,	
	-67°F(-55°C)	72°F(22°C)	.260**(127*c)	350°F (U///°C)
Fau (ksi.] (HPa)	[9.86] (67.9)	[8.66] (59.7)	[5.76] (39.5)	(3.97) (27.3)
Stnd.Dev.[ksi](MPa) Range [ksi](MPa)	[0.60] (4.1) [8.85 - 10.32] (60.9 - 71.1)	[0.29] (4.0) [8.26 - 8.98] (56.9 - 61.9)	[0.42] (2.9) [5.33 - 6.23] (39.5 - 49.5)	[0-09] (0-6) [3.83 - 4.09] (26.4 - 28.2)
No. of Specimens	5	5	5	5
GE [Mei](GPa)	[1.07] (7.37)	(0.74) (5.10)	[0.36] (2.46)	[0.14] (0.98
Stnd.Dev.[Msi](GPa) No. of Specimens	[0.003] (0.02) 5	[0.06] (0.41)	[0.04] (0.25)	[0.03] (0.21)
Test Nethod Reference		45° straight-sided s. [Vol. 6, p. 252		
	IN	erlaminar shear		
pisu [ksi](MPa) Stnd.Dev.[ksi](MPa) Range	[21.3] (147) [0,2] (1.4) [21.1 - 21.7] (145 - 150)	[15.0] (103) [0.2] (1.4) [14.8 - 15.3] (102 - 105)	[9.1] (63) [0.3] (2.1) [8.8 - 9.6] (61 - 66)	[8.0] (55) [0.4] (2.8) [7.5 - 8.6] (52 - 59)
No. of Specimens	5	5	5	5
Test Hethod Reference		asth	D2344	



Inplane Shear Stress-Strain Curves for SiC/5506 Composite Laminates. Figure 33.

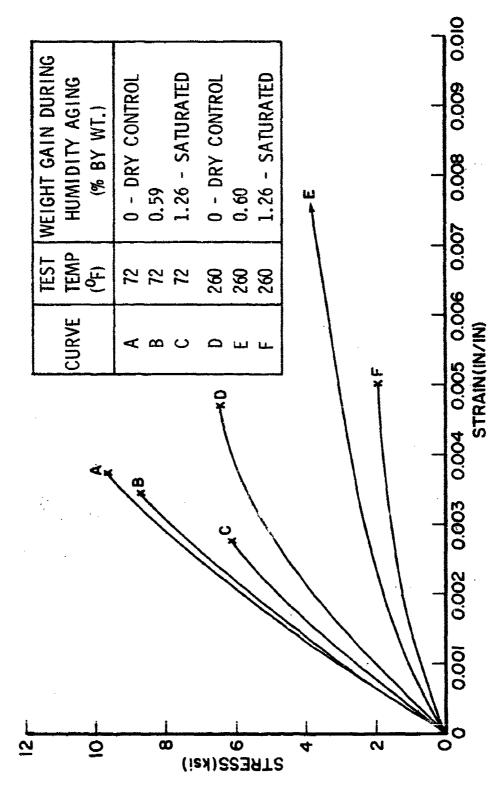
TABLE 28

TENSILZ, COMPRESSIVE AND SHEAR PROPERTIES OF SIC/5506 COMPOSITE LAMINATES AFTER HUMIDITY AGING

- AVCO 5 50°E 177°C)								
KO.	eg by - AVCO	8	SiC/Epoxy		00k	COMPRESSION: 90*)* (838#/334ri	24.0 P (1.29 ac)
ត	Leminate Sp. Gr 2.38	p. Gr 2	38			236.	T	77. 100.
	Nominal Fly intermess - 0.006/.inc No. of panels from which specimens	Angele Com	Odez inch	Mr. Gain's of orig.	1.31	1,31	27.0	0.79
	were tested in this table - 7	his table	- 2	dry wt.)			}) -
ŝ	Conditions	1 - 160°F(7.	Nging Conditions - 160°F(71°C) 6100N R.H.	Stnd. Dev. (*)	0.08	0.12	0.07	0.03
Intermess of each type specimen: Tension - 15 pl	Tension - 15 ply; Compr 10 ply; Shear - 15 ply	or - zdwo:		no or apecimens	•	n	n	n
				rou (kai) (MPa)	[kai] (MPa) [24.5] (169)	(117.7)(122)	(29.5)(203)	(18.6)(130)
TENSION: 90.	•			. Dev. [ksi] (MPa)	(0.8) (6)		(17)(12)	(9) (6 0)
73°F (22°C) 260°F (127°C)	┌	72°F (22°C) b	260°F(127°C)	Range	_	[15.6-19.0]	[26.9-31.4]	117.5-19.81
Γ	1	Ī			(164-177)	(161-201)	(185-216)	(121-136)
orig. 1.261	_	0.59	09.0	No. of Specimens	ហ	s	s	٧n
Strid. 26v.(%) 0.03 0.05		0.02	0.02	, in the second				;
s sum			ហ	F (Kali (MPa) [10.3] (71)	[10.3[(71)	[11.0](76)	(7.6) (52)	(5.7) (39)
				Stnd. Dev. [ksi] (MPa) [13.8] (26)	[3.8] (26)	[12.7] (19)	[6.2] (43)	(1.4) (10)
Fun (kail (MPa)(6.18) (42.6) [11.93] ((1.93) (8.51) [8.7]	[8.77] (60.4)	[3.82] (26.3)	No. of Specimens	w	ıν	'n	'n
1. Dev. [ksi] (Mpa)[0.69] (4.8)		(0.51) (3.5)	_	E. [Msi] (GPa) [2.85] (20)	[2.65](20)	(3.32) (23)	(4.19)(29)	[3.01](21)
	_	18.20-9.50)	_					
34.6~45.9) (12.2-15.1)		(56.5-65.5)	(22.7-29.4)	Stnd. Dev. [Ms1](GPa) [U.5] (4)	(*) (4) V	(9) (8:01	(0.8)(6)	10.73(5)
4178419	·-	n	n	No. of opening	,	,	,	,
Ftp1 [ks1] (MPa) [2.58] (17.8) [10.68] (4.7)		(2.26) (15.6)	(0.81) (5.6)	egu (uin/in) (ucm/cm)	20,480	11,1503	32,209	10,620
Stnd. Dev. [kei] (MPs) [0.80] (5.5) [0.10] (0.7)		(0.38) (2.6)	(0.22) (1.5)	Stnd. Dev.	6,650	7,230	008	9.470
No. of Specimens 5 5				No. of Specimens	'n	ທ	m	ın
E [Ms1] (GPa) [2.58] (17.8) [0.75] (5.2)		(3.08) (21.2)	(1.11) (7.6)	Test Method	ļ	t v	ACTIVE DISCORD	
Strd. Dev. [Mail (Gpa) 10.191().3) (0.281(1.9)				Reference			2	
mens 5		2 (11)	(75		INTER	INTERLAMINAR SHEAR		
				Excosure Time (hrs)	240	335	3842	3842
E [pin/in] (pon/on) 2763 5007		3417	7640	Wt. Gain(of orig.	1.071	1.001	0.63	0.67
Strd. Dev. 258 1074		307	9	dry wt.)	;	,	6	**
	<u>.</u>	<u></u>	ın	No. of Specimens	10	2 2	10	2.5
Test Method	ASTM D3039			isu (test) tubes	11 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	17 151 (49 3)	111 631780 0	ום שליופר שו
				Dev.	[ksil (MPa) [0.70] (6.3)	(0.13) (0.9)		
				facilitay! after		(48.3~59.4)	(76.3-83.1)	
				No. of Specimens	01	in.	01	w.
			<u>:=</u>	Test Method		ASTR	ASTM 02344	

NOTES:

Lhook saturation at aging conditions.
Chamber malfunctioned during aging. Total exposure time required to reach 0.65% weight gain does not reflect the normal time required to gain this amount of moisture for a small interlaminar shear specimes strain value represents maximum observed strain rather than ultimate values. Evidence of buckling on one specimen.
Excludes two specimens which exhibited evidence of buckling.
Surimate strain value represents maximum observed strain rather than ultimate values. Evidence of buckling on all five specimens.



The second second second

Tensile Stress-Strain Curves for Unidirectional SiC/5506 Composite Laminates After Humidity Aging at 160°F (71°C) and 100% R.H.: 90° Fiber Orientation. Figure 34.

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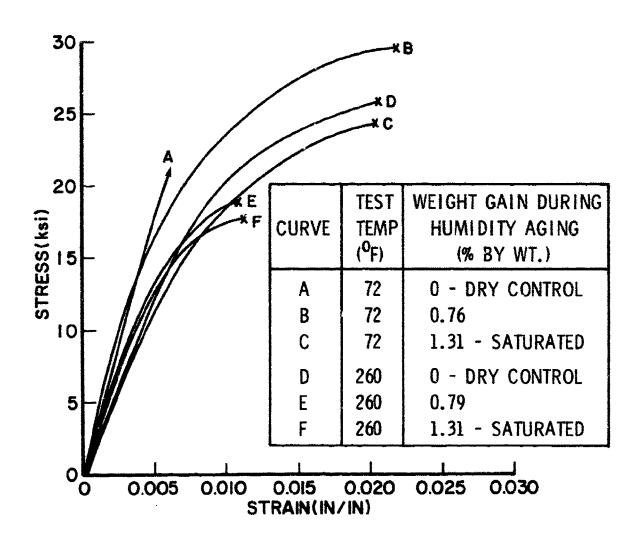


Figure 35. Compressive Stress-Strain Curves for Unidirectional SiC/5506 Composite Laminates After Humidity Aging at 160°F (71°C) and 100% R.H.: 90° Fiber Orientation.

TABLE 29 CREEP PROPERTIES OF SIC/5506 COMPOSITE LAMINATES

The second of th

	Composite Material Properties					
Fiber - 5.6 Maximum Tem Resin Conte Fiber Conte Void Conten Test Mathod	mtom - SiC/5506 mil SiC Matrix - AVCO perature Rating - 350°P(177° nt - 19.20 by wt. nt - 58.00 by vol. t - 1.10 by vol Straight-sided tension ASTM D2290 and D3039		· 0.0065 inch h specimens were · 16			
		CREEP				
Temperature		(0,+45,-45,0,0,-45,+45,0,90.0)	±45°			
72°F (22°C)	Stress Lavel [kmi] (MPa) Creep Strain, 500 hr(%) No. of Specimens Residual Strength[ksi] (MPa) No. of Specimens	[83.5] (575) 0.0121 3 {105.3] (726) 3	[13.96] (95,50) 1.0280 3 [16.13] (117) 3			
	Stress Level [Kmi] (MPm) Creep Strain, 500 hr(%) No. of Specimens Residual Strength[Kmi] (MPm) No. of Specimens	171.6) (493) 0.0102 2 [102.7] (708) 2	[12.13] (83.58) 0.5312 3 [17.24] (119) 3			
	Stress Level [kgi] (MPa) Creep Strain, 500 hr(%) No. of Specimens Residual Strength[ksi] (MPa) No. of Specimens	(59.6) (411) 0.0070 3 (102.5](706) 3	(10.39) (71.59) 0.4480 3 (17.32) (119) 3			
260°F (127°C)	Stress Level [ksi] (MPa) Creep Strain, 500 hr(%) No. of Specimens Residual Strength[kai] (MPa) No. of Specimens	[82.0] (565) 0.03136 1 {106.6](734)	[8-07] (55.60) ——1 [17.86] (123)			
	Stress Level [kmi](KPa) Creep Strain, 500 hr(s) No. of Specimens Residual Strength[kmi](MPa) No. of Specimens	[70-3] (484) 0.0180 1 ⁵ -7 [101-4] (699) 2	[5.76] (39.69) 3.2171 ² 2 [15.87] (109) 3			
	Stress Level (kgi](NPa) Creep Strain, 500 br(%) No. of Specimens Residual Strength[kgi](NPa) No. of Specimens	[58.6] (404) 0.0216 3 [105.6] (728) 3	[5.12] (15.28) 1.3228 ² 2 [16.57] (111) 3			
350°F (177°C)	Stress Level (kgi] (MPa) Creep Strain, 500 hr(%) No. of Specimens Residual Strength[kgi] (MPa) No. of Specimens	[60.4] (416) 0.0674 1 ^{2.7} [94.1] (648)	(3.17) (21.84) 			
	Stress Level [kzi] (MPm) Creep Strain, 500 hr(%) No. of Specimens Residual Strength[kmi] (MPm) No. of Specimens		[1.59] (10.96) 4 3 [15.68] (108)			
	Stress Level [ksi] (MPR) Creop Strain, 500 hr(%) No. of Specimens Residual Strength[ksi] (MPA) No. of Specimens		(1.19) (8.20) 4 3 (15.35) (106) 3			

Strain exceeded limits of gages early in test. Two specimens failed during test.

Strain exceeded gage limit during test on one specimen.

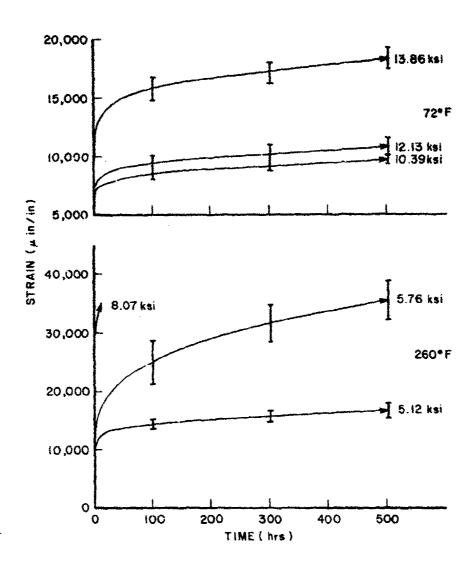
Sali three specimens failed within first ten minutes.

Strain exceeded limits of gages early in test.

The openimen failed on loading.

Strain gages malfunctioned on two specimens.

Strain gages malfunctioned on one specimens.



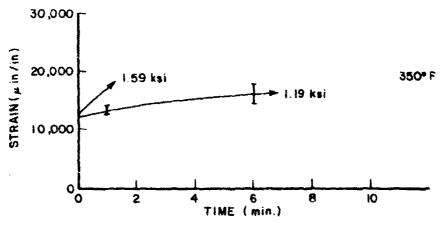


Figure 36. Tensile Creep Behavior of Bidirectional SiC/5506 Composite Laminates: +45° Fiber Orientation.

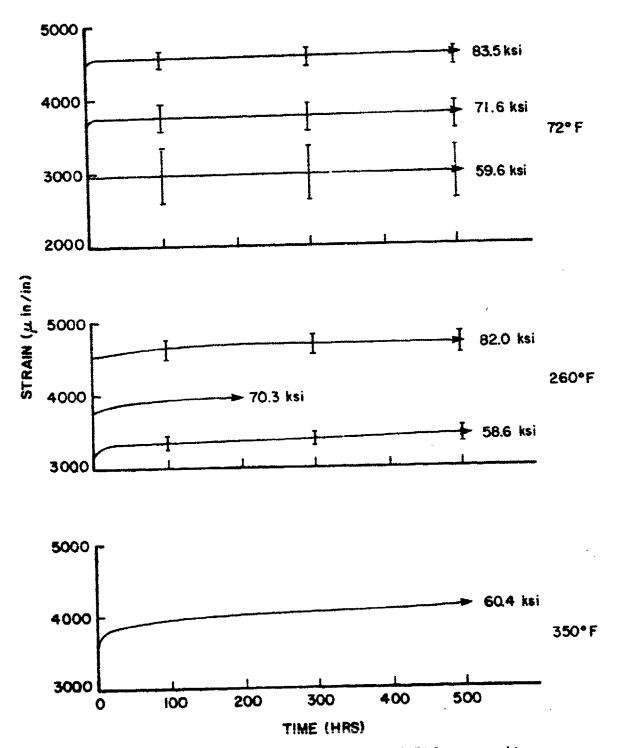


Figure 37. Tensile Creep Behavior of SiC/5506 Composite Laminates: (0,+45,-45,0,0,-45,+45,0,90,0)s Fiber Orientation.

TABLE 30

STRESS RUPTURE PROPERTIES OF SiC/5506 COMPOSITE LAMINATES

	Composite Material	Properties	
Fiber - 5.6 Maximum Temm Resin Conte Fiber Conte Void Conten Test Method	stem - Sic/Epcry mil Sic Matrix - AVCO perature Rating - 350°F(177° nt - 19.2% by wt. nt - 58.0% by vol. t - 1.1% by vol Straight-sided tension ASTM D2290 and D3039		cimens - 16
	STRESS RUP	TURE	
Temperature	Fiber Orientation	(0,+45,-45,0,0,-45,+45,0,90,0) _s	<u>+</u> 45°
72°F (22°C)	Stress Level[ksi](MPa) Time to Failure(hrs) No. of Specimens Residual Strength[ksi](MPa) No. of Specimens	[83.5] (575) 500+ 3 [105.3] (726) 3	[13.86] (95.50) 500+ 3 [16.93] (117)
	Stress Level[ksi](MPa) Time to Failure(hrs) No. of Specimens Residual Strength[ksi](MPa) No. of Specimens	[71.6] (493) 500+ 3 [102.7] (708)	(12.13) (83.58) 500+ 3 [17.24] (119) 3
260°F (127°C)	Stress Level[ksi] (MPa) Time to Failure(hrs) No. of Specimens Residual Strength(ksi] (MPa) No. of Specimens Stress Level[ksi] (MPa) Time to Failure(hrs) No. of Specimens Residual Strength[ksi] (MPa)	3 [70.3] (484) 500+ 3 [101.4] (699)	[8.07] (55.6) 202+1 3 [17.86] (123.1) 1 [5.76] (39.7) 500+ 3 [15.87] (109.3)
350°F(177°C)	No. of Specimens Stress Level[ksi](MPa) Time to Failure(hrs) No. of Specimens	[60.4] (416) 500+ 2 [94.1] (648)	(3.17) (21.8) 0.08 3
	Residual Strength[ksi](MPa) No. of Specimens Stress Level[ksi](MPa) Time to Failure(hrs) No. of Specimens Lesidual Strength[ksi](MPa) No. of Specimens	2	0 (1.59) (11.0) 346+ ² 3 [15.68] (108.0)

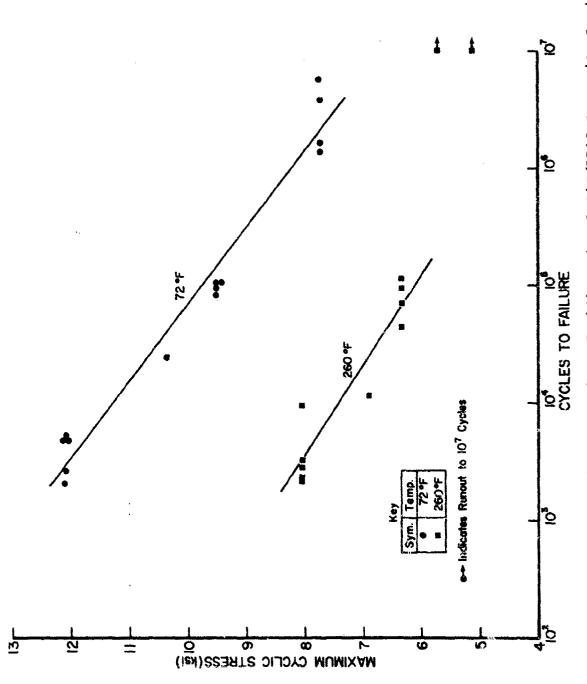
The specimen survived for 500 hrs. without failure. Two specimens survived for 500 hrs. without failure.

TABLE 31

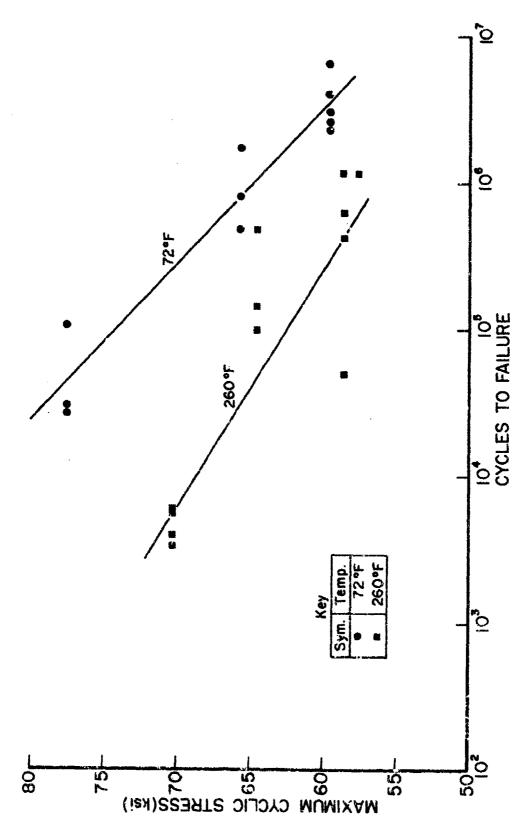
PATIGUE PROPERTIES OF SiC/5506 COMPOSITE LAMINATES

	Composite M	laterial Propertie	8	
Fiber - 5.6 m Maximum Tempo Resin Content Fiber Content Void Content	cem - SiC/5506 mil SiC Matrix - AVCO 5506 exature Rating - 350°F(177°C) c - 19.2% by wt. c - 58.1% by vol. - 1.0% by vol. Straight-sided Reference - tension	No. of panels in this tabl Thickness of ASTM D3039	Gr 2.34 hickness - 0.000 from which spec	imens were tested
	TENSILE	FATIGUE, R=0.1		
Temperature	Fiber Orientation	<u>+</u> 45°	0/+45/90(1)	0/+45/90 (1,2)
72°F(22°C)	Max. Stress[ksi](MPa) Lifetime (cycles) No. of Specimens Residual Strength[ksi](MPa) No. of Specimens Max. Stress[ksi](MPa) Lifetime (cycles) No. of Specimens Residual Strength[ksi](MPa) No. of Specimens Max. Stress[ksi](MPa) Lifetime (cycles) No. of Specimens Residual Strength[ksi](MPa) Lifetime (cycles) No. of Specimens Residual Strength[ksi](MPa) No. of Specimens	[12.12] (83.5) 3,534 5 0 [9.53] (65.7) 94,974 ³ 4 0 [7.79] (53.7) 2,663,831 4 0	[77.5] (534) 11,644 5 0 [65.6] (452) 475,439 ³ 4 0 [59.6] (411) 3,463,243 5 0	[83.3] (574) 7,237 ³ .4 0 (75.0] (517) 114,479 5 0 [62.5] (431) 1,895,681 ³ 4 0
260°F(127°C)	Max. Stress[ksi](MPa) Lifetime (cycles) No. of Specimens Residual Strength[ksi](MPa) No. of Specimens Max. Stress[ksi](MPa) Lifetime (cycles) No. of Specimens Residual Strength[ksi](MPa) No. of Specimens Max. Stress[ksi](MPa) Lifetime (cycles) No. of Specimens Residual Strength[ksi](MPa) Lifetime (cycles) No. of Specimens Residual Strength[ksi](MPa)	[8.06] (55.5) 2,118 5 0 [6.34] (43.7) 75,744 4 0 [5.76] (39.7) 107+3 1 [14.6] (100)	[70,3] (484) 3,110 5 0 [64.5] (444) 111,073 ³ 4 0 [58.6] (404) 346,552 ³ 4 0	

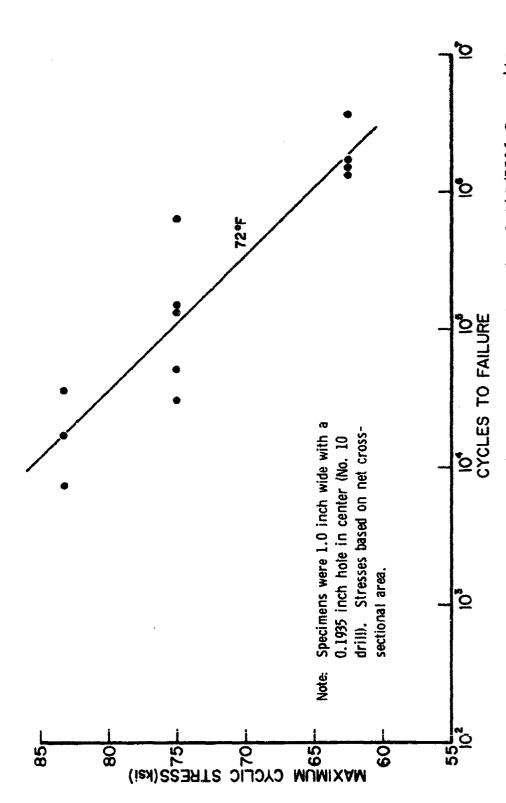
- MOTES: 1. Stacking sequence was (0, +45, -45, 0, 0, -45, +45, 0, 90, 0)s.
 - 2. These specimens had a 0.1935 inch (0.491 cm) hole in the center of the test section. Stresses calculated using net cross-sectional area.
 - 3. Excludes data for one specimen from bad panel.



Tensile-Tensile Fatigue Behavior of Bidiractional SiC/5506 Composite Laminates: $\pm 45^{\circ}$ Fiber Orientation, R = 0.10, 10 Hz. Figure 38.



Tensile-Tensile Fatigue Behavior of Multidirectional SiC/5506 Composite Laminates: (0,45,-45,0,0,-45,45,0,90,0) Fiber Orientation, R = 0.10, 10 Hz. Figure 39.



Tensile-Tensile Fatigue Behavior of Multidirectional SiC/5506 Composite Laminates: (0,45,-45,0,0,-45,45,0,90,0) Fiber Orientation, R = 0.10, 10 Hz. Figure 40.

TABLE 32

THERMOPHYSICAL PROPERTIES OF Sic/5506 COMPOSITE LAMINATES

	Сощооб	ite Material	Properties		
Haterial System - SiC/550 Fiber - 5.6 mil SiC M Maximum Temperature Ratine Resin Content - 19.1a by Fiber Content - 58.4a by Void Content - 1.0a by Thickness of each type spe Therm. Exp. 0° £ 90° - 8	atrix - AVCO 1 - 350°F(177 wt. vol. vol.	5506 (*C) Lami Aver No. in	this table ~	-2.35 ness -0.00 m which op 4	ecimens were tested
· · · · · · · · · · · · · · · · · · ·		HYSICAL PROPE		**************************************	
	-67°F(-55°C)	72°F(22°C)	260°F(127°C)	350*F(177	C) Test Method
Thermal Expansion ¹ . α_{χ} [µin/in-*F] (µcm/cm-*C) α_{χ} [µin/in-*F] (µcm/cm-*C)	[1.34) (2.41) [7.89](14.2)	[1.56] (2.81) [9.56] (17.2)	[2.01] (3.62) [18.8] (33.9)	[2.23] (4.0 [37.8] (68.	TMA ²
No. of Specimens per direction	3	3	3	3	
Specific Heat Cp[btw/lb*P](J/kg-*C)		1	\$:		92 psc³
No. of Specimens Thermal Conductivity k_[btu-ft/ft^-hr-'F] (W/m-"C) No. of Specimens	3 [0.5 <u>12]</u> (0.885) 2	3 [0.572] (0.996) 2	3 [0.621] (1.074) 2	3 [0.615] (1.064) 2	Comparative
Glass Transition Temp. Dry [°F](°C) Net [°F];°C)	[394] (201) [293] (145)		•		DMA ⁴
	THERMOPH	YSICAL PROPE	RTIES: 45°		
Thermal Expansion 1 a_{x}[\pi\n/\n-\P] (\pi\n/\cm-\C) No. of Specimens prr direction	[2.83] (5.10) 3	[3.33] (6.00) 3	(3.52) (6.33) 3	[4.07] (7. 3	32) TMA ²
Thermal Conductivity ¹ k _g [btu-ft/ft ² -hr-°F] (W/m-°C) No. of Specimens					

MOTES: 1. On the unidirectionally reinforced specimens, the x-direction is along the fiber axis, the y-direction is across the iiber axis, and the z-direction is through the thickness (identical to the y-direction). On +45° bidirectionally reinforced specimens, the x and y directions are identical and oriented at 45° to either fiber direction, while the z-direction is through the thickness.

- 2. Thermo-Hechanical Analysis.
- 3. Differential Scanning Calorimetry.
- 4. Dynamic Nechanical Analysis.
- ' ecimen humidity aged to saturation at 160°F (71°C) and 100% R.H. prior to testing.

4.3 HyE 2034D

This graphite/epoxy system consists of a pitch-based graphite fiber (VSC-32) from Union Carbide in Fiberite's 934 epoxy resin system. The fiber has nominal tensile properties of 300 ksi (2067 MPa) strength, 75xl0⁶ psi (517 GPa) modulus and 0.4% elongation with a specific gravity of 2.05. It was given a finish treatment by Union Carbide to enhance its interfacial bonding to epoxy resins. The resin is a 350°F (177°C) curing epoxy system.

Tables 33 through 46 present the data generated for this graphite/epoxy system. Figures 41 through 57 illustrate the stress-strain, fatigue, and creep behavior of the material as well as the effects of humidity aging upon selected composite properties. In addition a preliminary data sheet, distributed by Fiberite, is presented at the end of the section with a few selected property values generated by various sources.

While the high modulus of the VSC-32 fiber is reflected in the composite properties, the static strength levels exhibited by this system are uniformly lower, and in most cases substantially lower, than those exhibited by the other five systems tested. This is probably due to a reduced level of interfacial fiber-to-resin bonding. The pitch based graphite reinforcing fiber in this system was given a finish treatment to enhance its bondability to the matrix resin but the treatment still does not appear to be capable of providing the level of interfacial bond strength which is achieved with the nominal 30 Msi (207 GPa) modulus PAN based graphite fibers used in the other systems (Thornel 300 or G-160).

TABLE 33 PROCESSING CONDITIONS FOR HyE2034D COMPOSITES

Composite Processing Information

Material System - HyE 2034D

Fiber - VSC-32

Matrix - 934

Maximum Rated Temperature - 350°F (177°C)

HMG/Epoxy

Prepreg by -Fiberite

Laminate Processing Schedule

Layup Procedure: The prepreg was stored in a closed wrapper at 0°F (-18°C). Prepreg was warmed to room temperature before removal from wrapper to prevent moisture condensation on prepreg. Plies were cut to desired size with razor knife and stacked in desired sequence (release paper removed from each ply). The stack was placed in the autoclave according to the layup system illustrated in Figure 41. The corprene edge dam serves to restrict fiber flow.

Cure Schedule: Apply full vacuum and hold for 1/2 hour at room temperature. Heat to 250°F at a rate of 2-5°F/min. When temperature has reached 250°F apply 100 psi above bladder (while retaining vacuum). Hold at 250°F for 45 minutes then heat to 350°F at a rate of 2-5°F/min. Hold at 350°F for 2 hours then cool to 150°F at 2-5°F/min. Release pressure when temperature has reached 150°F, then release vacuum and remove panel from autoclave.

Postcure Schedule: None.

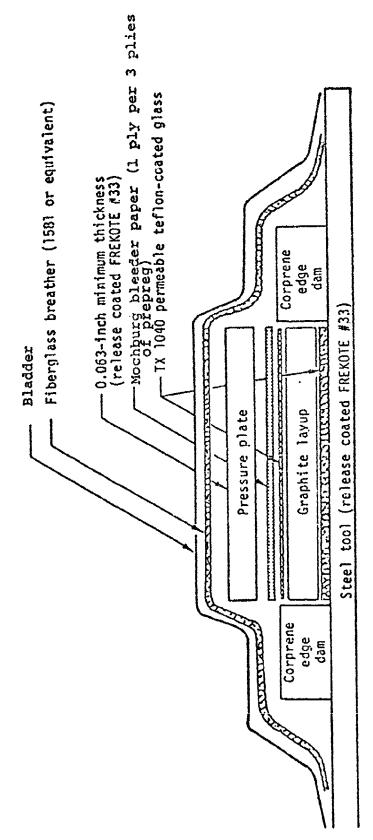


Figure 41. Layup System for HyE2034D Laminates.

TABLE 34
PREPREG AND COMPOSITE PHYSICAL PROPERTIES

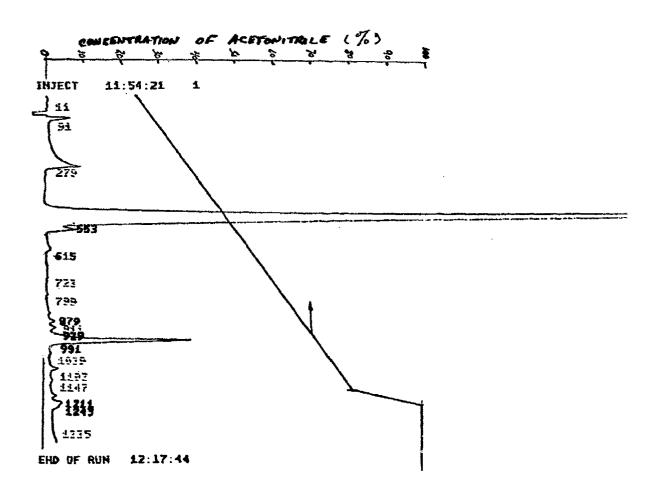
Material System - HyE 2034D Fiber - VSC-32 Matrix - 934 Maximum Rated Temperature - 350°F(177°C) Prepr Prepreg Physical Properties (Property) (Stnd.Dev.) (Range) (The system of the	I-C-V-14 Fiberite
(Froperty) (Stnd.Dev.) (Range) (TVolatile Content- 0.67% by wt. 0.04% 0.62-0.69 QCIResin Content- 39.2% by wt. 0.9% 38.3-40.2 Resin Flow- 22.4% by wt QCIResin Flow- 22.4% by wt QCIResin Flow- 12.45 min 0.20 min 12.23-12.63min No. of Rolls Involved - 1 Laminate Physical Properties (Stnd.Dev.) (Range) (Trunch of Panels- 33	I-C-V-14 Fiberite
Volatile Content- 0.67% by wt. 0.04% 0.62-0.69 QCI Resin Content- 39.2% by wt. 0.9% 38.3-40.2 Resin Flow- 22.4% by wt QCI Gel Time - 12.45 min 0.20 min 12.23-12.63min No. of Rolls Involved - 1 No. of Batches Involved - 1 Laminate Physical Properties 1 (Stnd.Dev.) (Range) (The No. of Panels- 33	I-C-V-14 Fiberite
Resin Content- 39.2% by wt. 0.9% 38.3-40.2 Resin Flow- 22.4% by wt QCI Gel Time - 12.45 min 0.20 min 12.23-12.63min No. of Rolls Involved - 1 No. of Batches Involved - 1 Laminate Physical Properties (Stnd.Dev.) (Range) (Tourish of Panels- 33	
No. of Panels- 33 (Stnd.Dev.) (Range) (T	Rl5 Fiberite I-C-F-42 Fiberite n G2 Fiberite
No. of Panels- 33	
Resin Content- 24.5% by wt. 1.0% 23.0-27.0% AF	cid Digestion
Void Content- $^{\circ}$ 0 D2 Laminate Sp. Gr 1.80 D7 Fiber Sp. Gr 2.00 As reported by Fiber Matrix Sp. Gr 1.30 As reported by Fiber Thickness per ply- 0.0049 inch	

The properties reported here represent averages for all panels of this material used throughout the program.

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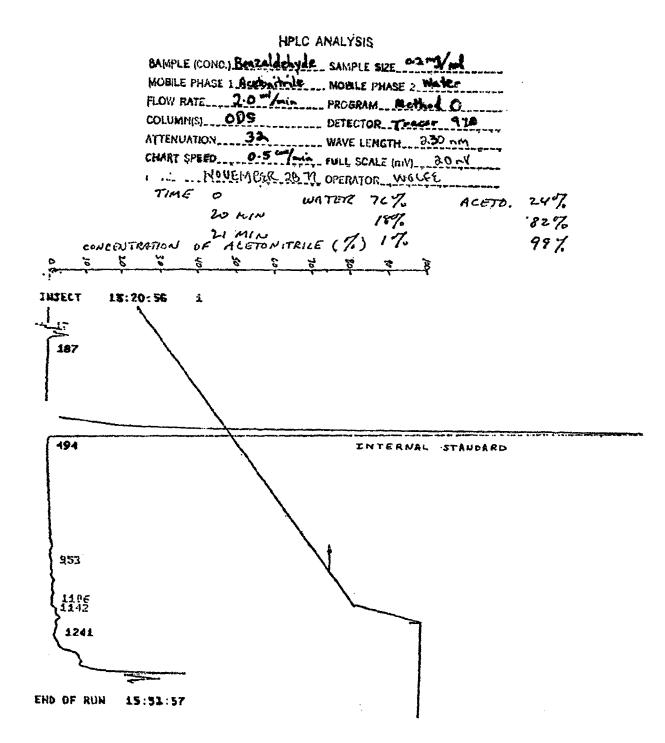
HPLC ANALYSIS

SAMPLE (CONC	HYE- 203	70 sample sze	15 mg/ml
MOBILE PHASE	1 Acetentry	E. MOBILE PHA	SE 2 Works
FLOW RATE	2.0 %in	PROGRAM	Method @
COLUMN(S)	003	DETECTOR	Tracor 970
		WAYE LENGT	
CHART SPEED_	ندامه 5.0	FULL SCALE	(m/y 20ml
DATE NOV	EMBER 30	11 OPERATOR_	Mol CE



HDV-38-79 11:54

Figure 42. HPLC Analysis of Fiberite 934 Epoxy Resin.



964-25-75 X5.26

Figure 43. HPLC Analysis of Benzaldehyde.

TABLE 35
TENSILE PROPERTIES OF HyE2034D COMPOSITE LAMINATES

	Cosquesite	Material Propertie	29		
Material System - HyR F.Junc - VSC-32 - Hats	20340 rix + 234	Prepres by -	i	IBIC/Epony	
Miximum Rated Tun-cont		Laminate Sp. Nominal Ply	Thickness - 0.004	inch	
Sesin Content - 21.31 Fiber Content - 63.31		No. of panels	s from which spuc	imans ware tested	
Void Content - 0	•	in this tab			
Thickness of each type	specimen: O* - 6	bfA : 30.	- 15 ply		
		TENSION: C*			
	-67°F(-55°C)	72*8 (32*0)	360.8 (154.C)	350*P(177*C)	
F _X (ksi)(ATa)	(122.3) (843)	(106.5) (734)	[133.5] (920)	(135.0) (930)	
Stud.Dev.(ksi)(:Pa) Range (ksi)(:Pa)	(29.2) (201) (90.7-157.0)	(33.8) (233) (72.1-151.6)	(26.7) (184) (96.5-167.3)	[26.1] (180) [120.0-165.0]	
omeje (ABAS (FRG)	(625-1082)	(497-1044)	(665-1153)	(896-1137)	
No. of Specimens	5	5	5	\$	
r ^{tpl} (ksi)(:Pa)	(122.3) (843)	{106.5} (734)	[133.5] (920)	(135.0) (930)	
Stad_Dev. (ksi) (MPa)	{29.2} (201)	[33.8] (233)	(26.7) (184)	(26.1) (180)	
No. of Specimens	5	5	5	S	
Ex (MSi) (GPa)	(55.9) (385)	[44.5] (307)	(48-4) (333)	(48.71 (336)	
Stad.Dev.[Hsi](GPa)	(10.6) (73)	(3.1) (21)	[3.2] (22)	(3.8) (26)	
No. of Specimens	5	5	5	5	
ε (μin/in)(yem/cm)	2150	2080	2780	2660	
Stnd.Dev.	550	570	250	520	
No. of Specimens	4	5	5	5	
v _{xy}	0.30	0.22	0.32	9.30	
Stnd. Dev.	0.06	0.17	0.09	0.06	
No. of Specimens	3	S	1 5	5	
Test Method Reference	Straight-sided tecsion ASTM 03039				
		TENSION: 90°			
rtu (ksi) (:Pa)	(2.19) (15.1)	(2.07) (14.3)	[1.73] (11.9)	[1.47] (10.1)	
Stnd. Dev. [koi] (MPa)	(0.52) (3.6)	(0.24) (1.7)	(0.38] (2.6)	[0.32] (2.2)	
Pange	[1.56-2.68]	(1.81-2.34) (12.5-16.1)	[1.24-2.21] (8.5-15.2)	[0.91-1.92] (6.3-13.2)	
No. of Specimens	(10.7-18.5)	5	5	9	
ry [ksi] (XPa)	(2.19) (15.1)	(2.07) (14.3)	(1.73) (11.9)	(0.97) (6.7)	
Stad.Dev. [ksi] (NPA)	(0.521 (3.6)	{0.24} (1.7)	(0.38) (2.6)	(0.271 (1.9)	
No. of Specimens	5	5	5	To	
Ey (Hei) (Gra)	(0.92) (6.3)	[0.87] (6.0)	[0.79] (5.4)	[0.98] (6.8)	
Sind Day (Ksi) (Gra)	[0.10] (0.7)	(0.03) (0.2)	(0.01) (0.07)	[0.18] (1.2)	
Mo. of Specimens	5	5	5	10	
ey [pin/in] (pen/em)	2260	2360	2220	1844	
Sind, Dev.	490	297	507 S	436	
No. of Specimens	S	1		•	
v_{yx}^{t}	0.0051	0.0041	0.0051	0.0061	
Sind. Bev.					
to, of Specimens	« pr.				
Test Sethod		Straight-sided t	ensi o n		
Peference		DEDER MICA			

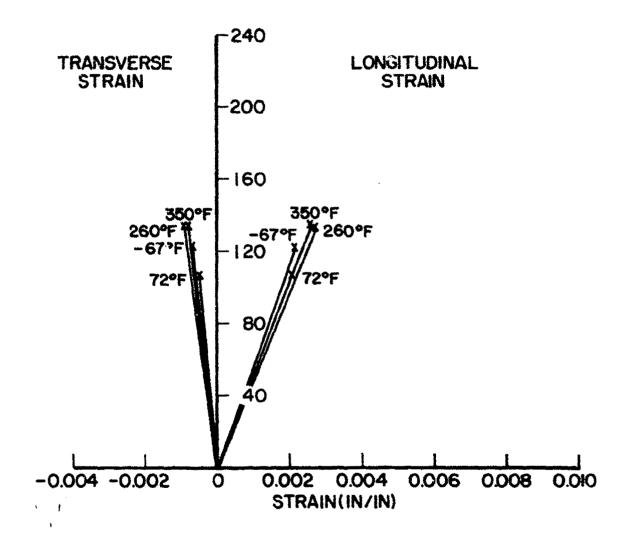


Figure 44. Tensile Stress-Strain Curves for Unidirectional HyE 2034D Composite Laminates: 0° Fiber Orientation.

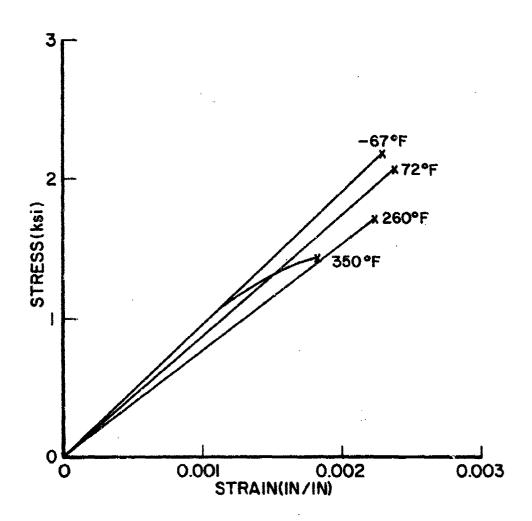
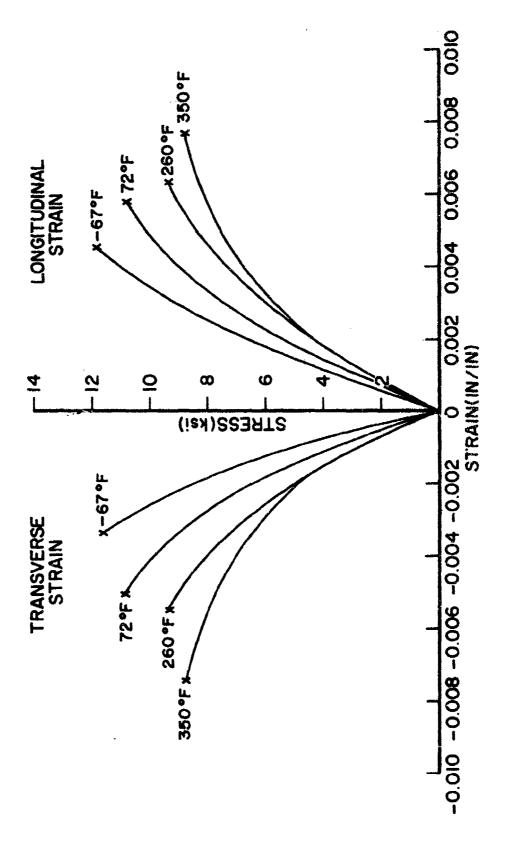


Figure 45. Tensile Stress-Strain Curves for Unidirectional HyE 2034D Composite Laminates: 90° Fiber Orientation.

TABLE 36
TENSILE PROPERTIES OF HyE2034D COMPOSITE LAMINATES

	Composite	Material Properti	es	
Naterial System - NyE 2034D Fiber - VSC-32 Matrix - 934 Maximum Eated Temperature - 350°F(177°C) Resin Content - 24.8% by wt. Fiber Content - 67.9% by vol. Void Content - 0		Propreg by - Fiberite NMG/Epoxy Laminate Sp. Gr 1.80 Nominal Ply Thickness - 0.0051 inch No. of panels from which specimens were tested in this table - 10 Thickness of specimen - 8 ply		
	T	ENSION: ±45°		
	-67°F(-55°C)	72°F (22°C)	260°F(127°C)	350°F(177°C)
Ptu [ksi] (MPa) Stnd.Dev.(ksi] (HTa)	[11.86] (81.7) [0.46] (3.2)	[10.85] (74.8)	[9.39] (64.7) [).29] (2.0)	[8.76] (60.4) [0.34] (2.3)
Range [koi](MP4) Po. of Specimens	[11.34-12.45] (78.1-85.8) 5	[10.29-11.18] (70.9-77.0) 5	[8.95~9.75] (61.7~67.2) 5	[8.42-9.13] (58.0-62.9) 5
F _X (ksi)(MPa)	[4.26] (29.4)	[4.58] (31.6)	[3.50] (24.1)	[2.95] (20.3)
Stnd.Dev.[ksi](MPa) No. of Specimens	[0.38] (2.6) 5	[0.34] (2.3) 5	[1.03] (7.1) 5	[0.39] (2.7)
rt (Msi)(GPa)	[3.50] (24.1)	[2.74] (18.9)	[2.23] (15.4)	[2.41] (16.6)
Stnd.Dev.[Msi](GPa) No. of Specimens	[0.11] (0.8) 5	(0.07) (0.5) 5	(0.51) (3.5) 5	[0.30] (2.1)
ctu [pin/in] (pcm/cm;	4500	5780	6390	7680
Stnd. Dev. No. of Specimens	480 5	640 5	1480 5	950 5
v_{xy}^{t}	0.74	0.87	0.85	0.96
Stnd. Dev. No. of Specimens	0.04 5	0.12 5	0.11 5	0.14
Test Rethod Reference	ASTH D3039			



Tensile Stress-Strain Curves for Bidirectional HyB 2034D Composite Laminates: +45° Fiber Orientation. Figure 46.

TABLE 37
TENSILE PROPERTIES OF HyE2034D COMPOSITE LAMINATES

Composite Actorial Properties							
Ratorial System - ByE Fiber - VSC-12 Maximum Rated Temperat Proin Content - 24.34 Fiber Content - 67.71 Void Content - 4 O Thickness of each type	Hatrix - 934 tura - 350*F(177*C) by wt. by wol.	Fiberite Gr 1.81 Thickness - 0.004 s from which speci					
TEMSION: (0, +45, -45, 0, 0, -45, +45, 0, 90, 0)							
	-67°F(-55°C)	72°F(22°C)	260°F(127°C)	350°F (177°G)			
Fru [ksi](PFa)		[75.8] (522)	[83.8] (577)	[82.8] (570)			
Stnd.Dev.[ksi](NPa) Bange [ksi](NPa) No. of Specimens		(8.1) (56) (65.7-83.0) (453-572) 5	(3.3) (23) (80.4-88.2) (554-608)	[8.7] (60) [71.4-90.8] (492-626)			
rtpl [ksi](MPa) Stnd.Dev.[ksi](MPa)		(67,1) (462) [7.9] (54)	[33.8] (577) [3.3] (23)	[82.8] (570) [8.7] (60)			
No. of Specimens		\$	5	5			
Et (Mei)(GPA)		{28.4] (196)	[26.7] (184)	[28.0] (193)			
Sind.Dev.[Hsi](GPa) No. of Specimens		(1.7) (12) S	(1.1) (8) 5	(3.9) (27) S			
ctu [pin/in](pen/cm)		2725	3100	2720			
Stnd.Dev. No. of Specimens		320 5	360 3	190 \$			
v _{xy}		0.415	0.400	0.382			
Stnd. Dev. No. of Specimens		 1	0.044 5	0.071 S			
Test Muthod Reference							
TENSION: (0, +45, -45, 0, 0, -45, +45, 0, 90, 0) with 0.1935 inch (0.491 cm)							
P ^{tu} [ksi](NPm)		[64.7] (446)					
Stnd.Dov. (ksi) (MPa) Range		(2,3) (16) (61,2-67,1) (422-462)					
No. of Specimens		S					
ry (kai) (MPa)							
Stnd.Dev. [ksi] (HPa) No. of Specimens							
Ey (Mmi) (GPa)							
Stnd.Dev.[Msi] (GPa) No. of Specimons							
e ^{tu} {µin/i:}(µcm/cm)							
Stnd. Dov. No. of Specimens							
v_{yx}^t							
Sind. Dav. Ko. of Specimens							
Tent thettent	•						
Kefevence							

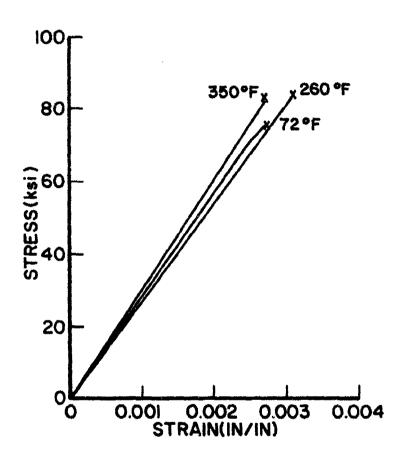


Figure 47. Tensile Stress-Strain Curves for Multidirectional HyE 2034D Composite Laminates: (0,45,-45,0,0,-45,45,0,90,0)₈ Fiber Orientation.

TABLE 38

COMPRESSIVE PROPERTIES OF HyE2034D COMPOSITE LAMINATES

	Composite	Material Propertie	95	
Material System - MyE Fiber - VSC-32 Matr Eaximum Rated Temperat Rosin Content - 23.74 Fiber Content - 69.14 Void Content - 40 Thickness of each type	ix - 934 ure - 350°F(177°C) by wt. by wol.	Mc. of panels from which specimens were tested in this table - 2		
	cor	wression: 0°		
	-67°F(-55°C)	72°F(22°C)	260°F(127°C)	350°F(177°C)
Fx [ksi] (MPa)	[53.81] (371)	[48.51] (334)	[42.00] (289)	[42.03] (290)
Stnd.Dev.[ksi](MPa) Range [ksi](Fa) No. of Specimens	[5.69] (39) [45.87 - 61.24] (316 - 422) 5	[5.71] (39) [41.91 - 55.56] (289 - 383) S	[6.63] (46) [31.16 - 48.00] (215 - 331) 5	[6.95] (48) [32.21 - 48.53] [222 - 334) 4
r ^{cpl} [ksi] (MPa)	[35.66] (246)	[25.77] (178)	(22.75] (157)	[25.27] (174)
Stnd.Dev.[ksi](MPz) No. of Specimens	[6.28] (43) 5	[12.81] (88) 5	[9.73] (67) 5	[8.08] (56)
E ^C [Msi] (GPa)	[37.03] (255)	[45.90] (316)	[44.29] (305)	[43.42] (299)
X Stnd.Dev.[Msi](GPa) No. of Specimens	(3.70) (25)	[10.67] (74) 5	[7.77] (54) 5	[8.42] (58) 5
ε ^{cu} (μin/in)(μcm/cm)	1740	1300	1320	1180
Stnd. Dev. No. of Specimens	230 5	290 5	240 5	50 4
Test Method Reference	ASTM D3410			
	co	MPRESSION: 90°		
Fy [ksi] (MPa)	[19.08] (131)	[17.55] (121)	(13.05) (90)	[11.49] (79)
y Stnd.Dev. (ksi] (MPa) Range No. of Specimens	[2.67] (18) [15.12-20.88] (104 - 144)	[3.30] (23) (15.07-22.38) (104 - 154)	[1.13] (8) [12.08-14.69] (83 - 101) 5	[1.58] (11) [8.75-12.50] (60 - 86) 5
Fopl [ksi](MPa)	[6.76] (47)	[3.17] (22)	[6.58] (45)	[2.19] (15)
Stnd.Dev. [ksi] (MPa) No. of Specimens	[6.03] (41) 4	[2-44] (17) 4	[5.24] (36) 5	[1.39] (10) S
E _y [Msi](GPa)	[1.76] (12)	[1.62] (11)	[1.14] (8)	(0.92] (6)
Stnd.Dev.[Msi](GPa) No. of Specimens	[0.78] (5) 4	[0.24] (2)	[0.26] (2) 5	[0.12] (1)
εν [μin/in] (μcm/cm)	19,980	35,950	13,880	25,040
Sund. Dev. No. of Specimens	1,540	12,220	3,970 5	5,250 5
Test Method Reference	ASTM D3410			

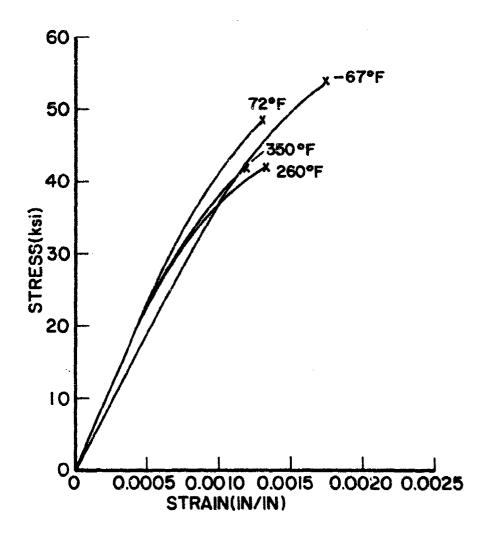
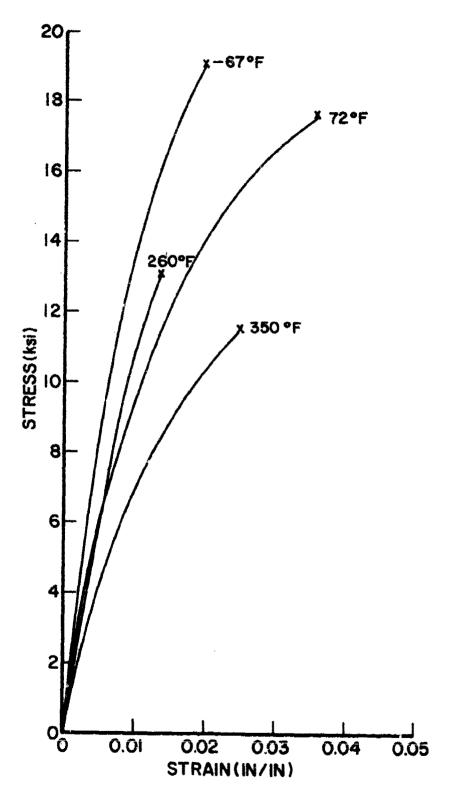


Figure 48 Compressive Stress-Strain Curves for Unidirectional HyE 2034D Composite Laminates: 0° Fiber Orientation.



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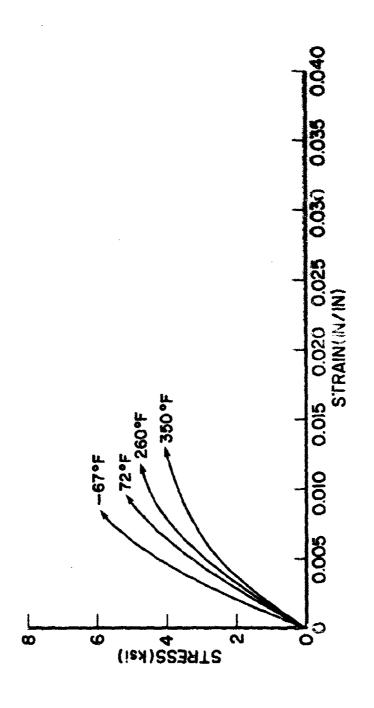
Figure 49. Compressive Stress-Strain Curves for Unidirectional HyE 2034D Composite Laminates: 90° Fiber Orientation.

TABLE 39
FLEXURAL PROPERTIES OF HyE2034D COMPOSITE LAMINATES

	Composite	Material Propertie	es			
Material System - HyE	2034D	Prepreg by -	Fiberite	нмс/Ероху		
Fiber - VSC-32 Matr Maximum Rated Temperat Resin Content - 23.4% Fiber Content - 69.8% Void Content - W	Nominal Ply Thickness - 0.0049 inch Nontent - 23.4% by wt. Nontent - 69.8% by vol. Intent - W ss of each type specimen: 0° - 14 ply; 90° - 14 ply					
	1	FLEXURE: 0°				
-67°F(-55°C) 72°F(22°C) 260°F (127°C) 350°F (177°C)						
Ffu [ksi] (MPa)	[86.9] (599)	[90.2] (621)	[66.6] (459)	[66.9] (461)		
Stnd.Dav.[ksi](APa) Range [ksi](MPa)	[17.1] (118) [62.2-107.1] (429-738)	[1.9] (13.1) [87.4-91.9] (602-633)	[2.5] (17.2) [62.8-69.0] (433-475)	[3.0] (21.0) [63.3-70-0] (436-482)		
No. of Specimens	5	5	5	5		
Ef [Msi](GPa)	[35.3] (243)	[41-6] (287)	[37,5] (258)	[40,3] (278)		
Stnd.Dev. [Msi] (GPa) No. of Specimens	(10.9) (75) 5	[1.6] (11.0) 5	[9,5] (65,5) 5	[3.0] (21.0)		
Test Method Reference	4 pt. flexure Design Guide, Ja	on. 1971 Correspo	onds to ASTM D790 points and loading			
		FLEXURE: 90*	· .			
rfu [ksi] (MPa)	[5.57] (38.4)	[5,30] (36.5)	[3.67] (25.3)	[2,80] (19.3)		
Stnd.Dev.[ksi](MPa) Range [ksi](MPa)	[0.19] (1.3) [5.28-5.75] (36.4-39.6)	[0,37] (2,54) [4.80-5.72] (33,1-39,4)	[0.17] (1.17) [3.38-3.78] (23.3-26.0)	[0.27] (1.5) [2.51-3.20] (17.3-22.0)		
No. of Specimens	5	5	5	5		
E ^f y [Msi](GPa)	[1.07] (7.4)	[1.09] (7.5)	[0.90] (6.2)	[0.77] (5.3)		
Stnd.Dev.[Msi](GPa) No. of Specimens	[0.04] (0.3)	[0.06] (0.4)	[0.04] (0.3) 5	[0.02] (1.5) 5		
Test Method Reference	4 pt. flexure Design Guide, J	an. 1971 Corresp	ponds to ASTM D790 g points and loadi			

TABLE 40
SHEAR PROPERTIES OF HYE2034D COMPOSITE LAMINATES

	Composit	e Material Propert	ris t	
Material System - MyR Fiber - VSC-32 Easts Maximum Rated Temperat Resin Content - 24.9% Piber Content - 67.9% Void Content - % 0 Thickness of each type	ris - 934 :uro - 350*P(177*C) by wt. by vok.	Nominal Ply No. of pand in this to	o. Gr 1.81 Thickness - O. Is from which s bie - II	pecimens were tested
	I	nplane shear		
	-67°F(-55°C)	72°F(22°C)	260°F(127°C).	350°F (1:777°C)
rsu (ksi) (MPa)	[5.93] (40.9)	[5.43] (37.4)	[4.69] (32.3%)	[4:38] (30.2)
Stnd.Dev.(ksi)(/Pa) Range [ksf](/Pa)	[0-23] (1.6) [5.67-6.22] (39.1-42.9)	[0.17] (1.2) [5.14-5.59] (35.4-38.5)	[0.14] (1.03) [4.48-4.883] (30.9-33-6)	[40.27] (0.2) [41.20-41.50] (29.0-31.49)
No. of Specimens	· 5-	5	5.	. 5 5
Gxy (Mail(CDa)	[1.07] (7.4)	(0.73) (5.0)	(0.66) (4.5)	[D-6D]) (4L-2))
Stnd.Dev. [Msi] (GPa) No. of Specimens	[0-14] (1.0) 5	[0.06] (0.4) 5	[0.02] (0.1))	(01.043) (01.33) 5)
Test Method Reference	· .	AST	H D358	
	INT	erlaminar shear		
risu (ksi) (MPa) Stnd.Dev.[ksi] (MPa) Range	[8.09] (55.7) [0.59] (4.1) [7.51-9.06] (51.7-62.4)	(7.18] (49.5) [0.46] (3.2) [6.45-7.85] (44.4-54.1)	[6.48] (44.6); [0.48] (3.3) [6.04-7.12]; [41.6-49.1];	(5.83) (400.2) (0.26) (2.8) (3.48+6.17) (377.7-42.5)
No. of Specimens Test Method Reference		Short Beam Sh vanced Composite D	ear 4:1	ı.



Inplane Shear Stress-Strain Curves for MyE 2034D Composite Laminates. Figure 50.

TABLE 41

The second of th

TENSILE, COMPRESSIVE, AND SHEAR PROPERTIES OF HYE 2034D COMPOSITE LAMINATES AFTER HUMIDITY AGING

	By 2034D	Prepred by	- Pilheribe	1, Cast.		8	(YMDDPERTOR: On		
Fiber - VSC-32 Matrix	Matrix - 934	Laminate Sp	Laminate Sp. Gr. ~ 1.80	Mary Epoxy		72.8 (22.6)	260'F (127'6) 73'F (33'C)	7347 (22°C)	1360°F (127°C)
Maximum Rated Jemperature + 350°F Resin Content - 24,3% by wt.	ure = 350°F by wt.	Nowinal Ply No. of pane	Mominal Ply Thickness -0.0048 inch No. of panels from which specimens	.0048 inch	Exposure Time (hrs) Wt. Gain(% of orig.	145	345	1706	2183
Fiber Content " 08.3% by vol. Void Content " 10	by well.	Were tested	ware tested in this table - 9	6 .	dry wt.)	6.74	0.76	1.33	100
Thickness of each type specimen:		T-10 2 - TOMOT TOMOT TO STATE TO BE STATE	Liche Louis	Maria Conditions - Iou'r 8 95-1004 R.H. 830n - 15 ply: Compt 20 plu:	Stnd. Dev. (v)	0.03	0.03	60.0	0,11
		Shear - 15 ply		· Fee		n	'n	w,	¥8:
	TENSION	ION: 90*			Fou [ksi] (MPa)		-	(13.391(92.3)[15.19](104.3	(110,04)(111)
	400m (000m)				Stnd. Dev. (kai) (MPa)			12,381(16.4)	1007 100 67
Exposure Time (hrs)	214.5	Z172	72-F(22-C)	260 F (127 C)	Range	112.00-17.591	_	1947	
Wt. Gain(% of orig.			104	385		(82.7-121.2)	1(77.6-107.6)		_
dry wt.) Stnd. Dev. (4)	50.0	6.79	1.18	1.191	Supplemental to the supple	.	'n	<u>د</u>	*
No. of Specimens	i vo		50.50	50.03	Popl (kail (MPa)	[ksil (MPa) [2.83] (19.5)	(2.49)(17.2)	15.58](38.4)	12.831/10 41
	1				Stnd. Dev: [ksi](Mas) [0.75][5.2]	[0.75] (5.2)	(6, 27) (1, 9)	361(0.4)	
	[xs1] (Mpa) [2.53] (17.4)	[11.72](11.9)	(2.05) (14.1)	(1.04) (7.2)	No. of Specimens	•		(5.8) (6.1)	15.53 [58:01]
Dev.	[kst] (HPa) [0.34] (2.3)	(0.17)(1.2)	(0.29) (2.0)	(0.13) (0.9)					+
Range [kail (MPa)	[ksi] (MPa) [2.13-2.85]		[1.65-2.38]	[0.88-1.21]	Ey (Mail (GPa)	(Mail (GPa) (1.92) (13.2)	[1.38](9,5)	[1.05] (7.2)	[1.07](7.4)
No. of Specimens	(14.7-19.6)	(9.9-13.0)	(11.4-16.4)	(6.1-8.3)	Stnd. Dev. [Mail(GPa) [0.79](5.4)	(0.79)(5.4)	10.38](2.6)	(0.13)(0.9)	10.171(1.2)
	,	ń	ń	'n	No. of Specimens	•	er:		2
rtpl [kei] (MPa)	[k#1] (MP#) [0.98] (6.7)	10.80) (5.5)	(1.49)(10.3)	10.89) (6.1)	ccu (pin/in) (pem/cm)	20,480	18.490	201	0
Strd. Dev. [ksi] (MPa) [0.20](1.4)	[0.20](1.4)	[0.16](1.1)	[0.29] (2.0)	(9.0) (0.0)	Stnd. Dev.	7,360	4.500	000	27.50
so. of Specimens	'n	ss.	ın	\$	No. of Specimens	4	y so	2 5	0,14
Ey [Mai] (GPA) [0.95] (6.5)	(6.95) (6.5)	(0.71)(4.9)	(11.00) (6.9)	(0.52) (3.6)	Test Method				
Stnd. Dev. [Hal] (GPa) [0.03] (0.2)	[0.03](0.2)	[0.04](0.3)	(0.3)	(9.0) (60.0)	Reference		ASTM	ASTM D3410	
No. of Specimens	wn	5	_	M		INTER	INTERLANINAN BHEAR	-	
Eta (nin/in) (nom/om)	2720	2660	2100	2200	Exposure Pime (hrs)		167	862	86.2
Stnd. Dev.	300	280	360	000	Nt. Gaini's of orig.	0.72	17.0	1.36,1	1,1,1
No. of Specimens	ĸ'n	w	5	287	Stnd. Dev. (%)	0.03	0.15	0.17	
Test Method		Chratche do.			No. of Specimens	10	'n	0	
Reference		ASTM 03039	5 cens 100		Pieu (kali (Oba)	(7 03) (40 K)	(c cc) (30 3)	0,7	
					Stnd. Dev. [kel] (HPa) [0.38](2.6) Rance [kel] (MDa) [6.14-7-41]	[0.38](2.6)	10.201(1.4)	10,351(2,4)	10.241(1:7)
					Speci	144.4-52.6)	(36.7-40.4)	10,135,193	(35.4-29.6)
					Test Method			•	
HOTE: 1. 1.00% *aturat	1.00% saturation at aging conditions				Baference		AS	ASTH D2344	

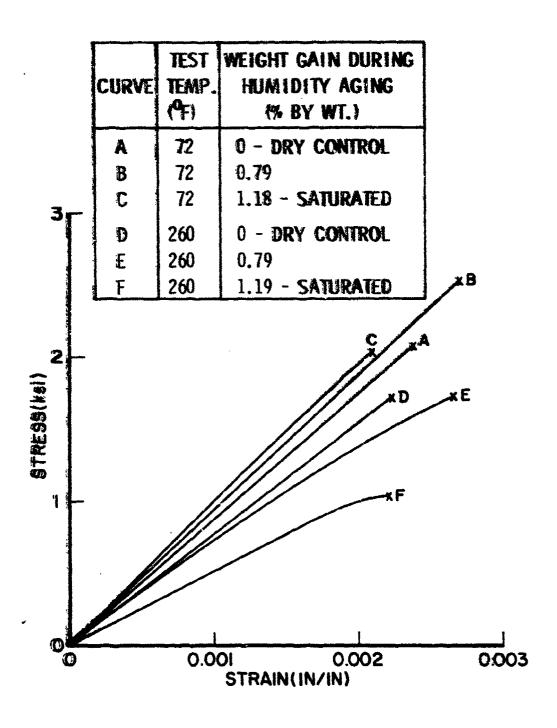


Figure 51 . Tensile Stress-Strain Curves for Unidirectional HyE 2034D Composite Laminates After Humidity Aging at 160°F (71°C) and 100% R.H.: 90° Fiber Orientation.

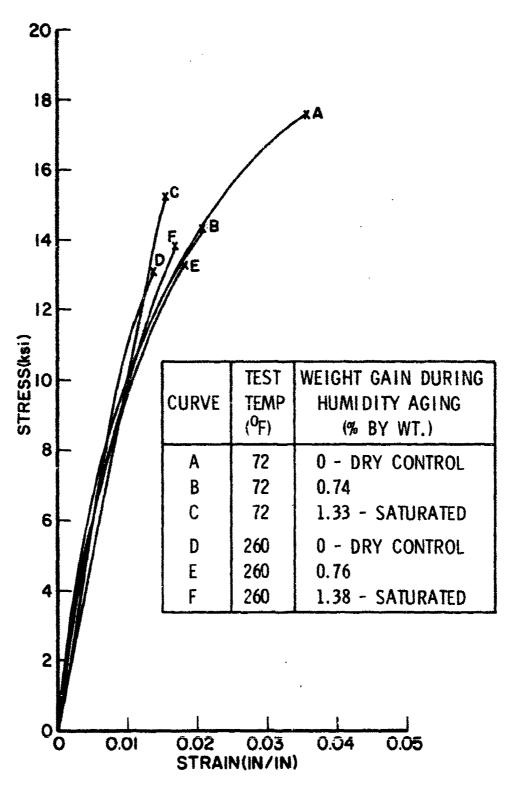


Figure 52. Compressive Stress-Strain Curves for Unidirectional HyE 2034D Composite Laminates After Humidity Aging at 160°F (71°C) and 100% R.H.: 90° Fiber Orientation.

TABLE 42 TENSILE CREEP PROPERTIES OF HyE2034D COMPOSITE LAMINATES

Composito Material Proposition

·			
Paterial Sys	utum - NyE 20340	Prepret by - Fiberite	HMG/Epoxy
Regin Conto	perature Rating - 350°F(177° nt - 23.8% by wt. nt - 67.9% by vol.	c) Laminate Up. Gr 1.8 Nominal Fly Thickness - No. of panels from whit tested in this table Thickness of each type	- 0.0050 inch ch specimons were - 18
Test Method Reference -		(0/±45/90) - 20 ply ±45° - 8 ply	31.04.20
		CHERP	
Temperature		(0,+45,-45,0,0,-45,+45,0,90,0) ₄	±45°
72°F (22°C)	Stress Level [ksi] (MPa) Creep Strain, 500 hr(%) No. of Specimens Residual Strenyth[ksi] (MPa) No. of Specimens	[60.7] (428) 0.0038 @ 191 hrs ³ 3 [76.8] (529) 3	[8.68] (59.8) 0.1182 3 [11.24](77.4) 3
	Strone Level [ksi] (MPm) Cree; Strain, 500 hr(%) No. of Specimens Residual Strength[ksi] (MPm) No. of Specimens	(53,1) (366) 0.0071 3 (75.5) (520)	{7.30} (50.3) 0.0998 3 [11.30](77.9)
	Stress Level [ksi] (NPa) Creep Strain, 500 br(4) No. Of Specimens Residual Strength(ksi] (NPa) No. Of Specimens	[45.5] (313) =0 3 [77.4] (533) 3	[5.43] (37.4) 0.0605 3 [11.33] (78.1)
260°F (127°C)	Stress Level (ksi](MPa) Creep Strain, 500 hr(%) No. of Specimens Residual Strength[ksi](MPa) No. of Specimens	(69.0) (413) 0.0036 @ 7 hrm' 3	[6.57] (45.3) 0.2981 @ 135 hrs ¹ 3 [11.12](76.6)
	Stress Level (ksi](MPa) Creep Strain, 500 hr(%) No. of Specimens Mosidual Strength(ksi](MPa) No. of Specimens	[50.0] (345) -0.00884 [77.0] (531)	(5,63) (38.8) 0.2154 3 (11.97) (82.5) 3
	Stress Lovel [ksi] (MPa) Creep Strain, 500 hr(%) No. of Specimens Residual Strength[ksi] (MPa) No. of Specimens	[40.0] (276) ~0.0036 ⁴ 3 [80.4] (554) 3	[4.70] (32.4) 0.1419 3 [12.77] (11.0) 3
350°F (177°C)	Stress Level [ksi] (MPa) Creep Strain, 500 hr(%) No. of Specimens Residual Strength[ksi] (MPa) Mo. of Specimens	[66.2] (456) 0.0148 @ 342 hrs 3 [82.6] (569) 2	(5-25) (36.2) 0.3661 0 1 hg.1 3
	Stress Level [ksi] (MPa) Creep Strain, 500 hr(%) No. of Specimons Residual Strength (ksi) (MPa) No. of Specimens	[58.0] (430) -0.0034 ⁴ 3 [76.7] (528) 3	(4.38) (30.2) 0.8708 @ 95 hrs. ¹ 1 (7.33) (50.5) 3
	Stress Level (ksi] (NPa) Croep Strain, 500 hr(%) No. of Specimens Rusidual Strength(ksi) (MPa) No. of Specimens	[49.4] (340) -0.0020 ⁴ 3 [78.6] (542) 3	(3.50) (24.1) 1.0004 0 24 hrs. ¹ 3 [5.51] (38.0) 3

failure.

Specimen contractions noted at lower stress levels at both 260°F(127°C) and 350°F (177°C). May be due to relaxation of residual curing stresses.

Istrain exceeded gage limits during test.

Three aperimens failed during test.

Gripping tabs debonded from one specimen at 226 hrs. Specimens were retested without strain measurement and ran out to 500 hrs without

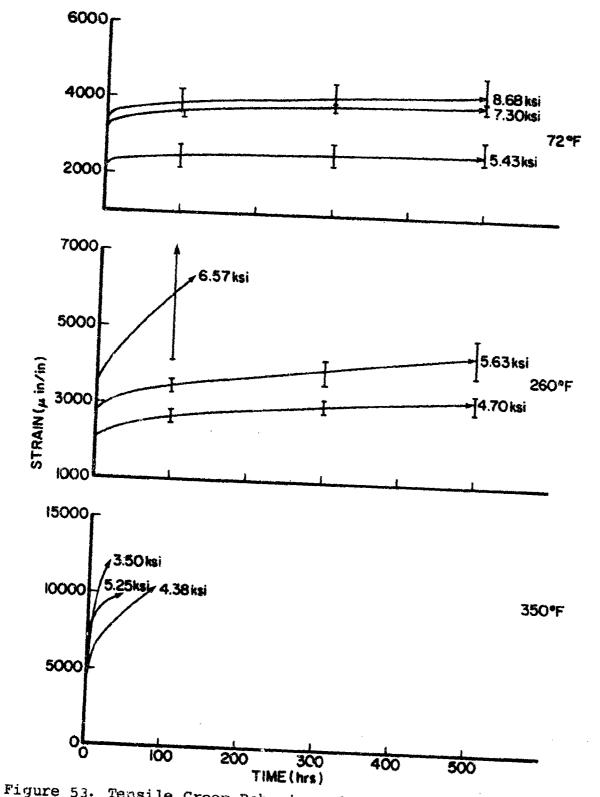


Figure 53. Tensile Creep Behavior of Bidirectional HyE2034D Composite Laminates: +45° Fiber Orientation.

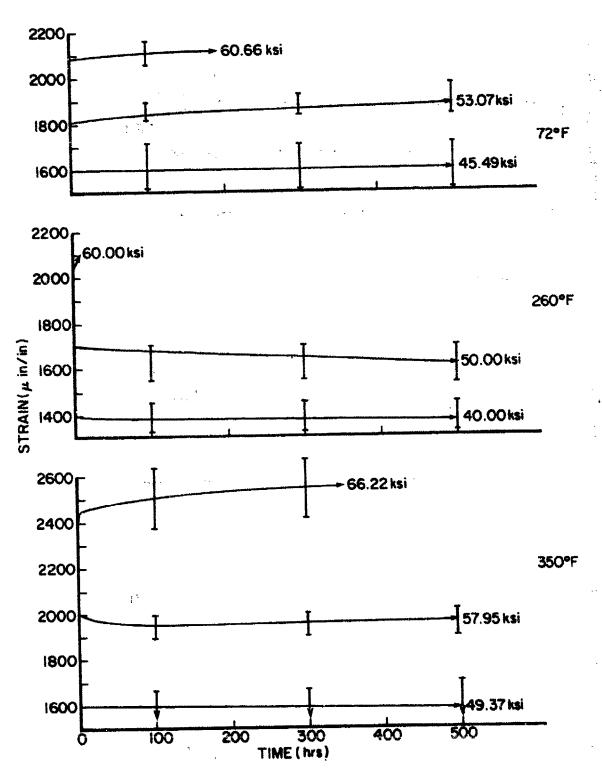


Figure 54. Tensile Creep Behavior of HyE2034D Composite Laminates: (0,+45,-45,0,0,-45,+45,0,90,0)_s Fiber Orientation.

TABLE 43
TENSILE STRESS-RUPTURE PROPERTIES OF HyE2034D
COMPOSITE LAMINATES

	Composite Material	Properties			
Material System - HyE2034D Fiber - VSC-32					
	STRESS RUP	TURE			
Temperature	Fiber Orientation	(0,+45,-45,0,0,-45,+45,0,90,0) _s	<u>+</u> 45°		
72°F (22°C)	Stress Level[ksi](MPa) Time to Failure(hrs) No. of Specimens Residual Strength[ksi](MPa) No. of Specimens	[60.7] (418) 500+ 3 [76.8] (529) 3	[8.68] (59.8) 500+ 3 [11.24] (77.4) 3		
	Stress Level[ksi] (MPa) Time to Pailure(hrs) No. of Specimens Residual Strength[ksi] (MPa) No. of Specimens	[53.1] (366) 500+ 3 [75.5] (520) 3	[7.30] (50.3) 500+ 3 [11.30] (77.9) 3		
260°F (127°C)	Stress Level[ksi] (MPa) Time to Failure(hrs) No. of Specimens Residual Strength[ksi] (MPa) No. of Specimens Stress Level[ksi] (MPa) Time to Failure(hrs)	0 [50.0] (345) 500+	[6.57] (45.3) 425+1 3 [11.12] (76.6) 2 [5.63] (38.8) 500+		
	No. of Specimens Residual Strength[ksi](MPa) No. of Specimens	[77.0] (531) 3	[11.97] (82.5) 3		
350°F (177°C)	Stress Level[kti](MPa) Time to Failure(hrs) No. of Specimens Residual Strength[ksi](MPa) No. of Specimens	[66.2] (456) 456+ 3 [82.6] (569)	[5.25] (36.2) 116 3 0		
	Stress Level[ksi] (MPa) Time to Failure(hrs) No. of Specimens Residual Strength[ksi](MPa) No. of Specimens	[58.0] (399) 500+ 3 [76.7] (528)	[4.38] (30.2) 500+ 3 [7.33] (50.5)		

TABLE 44 TENSION-TENSION FATIGUE PROPERTIES OF HyE2034D COMPOSITE LAMINATES

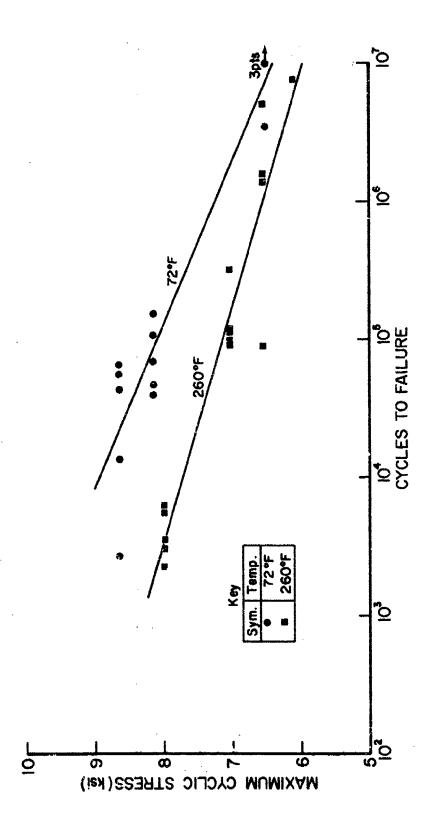
	Composite M	Material Propertie	\$			
Material System - HyE 2034D Propreg by - Fiberite HMG/Epoxy Propreg by - Fiberite HMG/Epoxy Maximum Temperature Rating - 350°F(177°C) Resin Content - 24.8% by wt. Piber Content - 67.9% by vol. Void Content - 0 O Test Method - Straight-sided tension Reference - ASTM D3039 Propreg by - Fiberite HMG/Epoxy Laminate Sp. Gr 1.81 Nominal Ply Thickness - 0.0050 inch No. of panels from which specimens were test in this table - 10 Thickness of each type specimen: +45° - 8 ply 0/+45/90° - 20 ply						
TENSILE FATIGUE, R=0.1 (3)						
Temperature	Fiber Orientation	<u>+</u> 45*	0/+45/90°	(1) 0/ <u>+</u> 45/90°(1,2)		
72°F(22°C)	Max. Stress[ksi](MPa) Lifetime (cycles) No. of Specimens Residual Strength[ksi](MPa) No. of Specimens Max. Stress[ksi](MPa) Lifetime (cycles) No. of Specimens Residual Strength[ksi](MPa) No. of Specimens Max. Stress[ksi](MPa) Lifetime (cycles) No. of Specimens Residual Strength[ksi](MPa) Lifetime (cycles) No. of Specimens Residual Strength[ksi](MPa) No. of Specimens	[8.68] (59.8) 22,706 5 0 [8.14] (56.1) 73,132 5 0 [6.51] (44.9) 7,715,394 4 [9.80] (68.0)	[75.8] (5 34,123 5 0 [73.9] (50 11,625 3 0 [72.0] (49 96,015 5 [79.2] (54	5,148 3 0 (60.00] (413) 20,000 3 (67.2] (463) 1 (67.2] (463) 1 (69.3] (401) 7,602,215+ 34		
260°F (127°C)	Max. Stress[ksi] (MPa) Lifetime (cycles) No. of Specimens Residual Strength[ksi] (MPa) No. of Specimens Max. Stress[ksi] (MPa) Lifetime (cycles) No. of Specimens Residual Strength[ksi] (MPa) No. of Specimens Max. Stress[ksi] (MPa) Lifetime (cycles) No. of Specimens Residual Strength[ksi] (MPa) Lifetime (cycles) No. of Specimens Residual Strength[ksi] (MPa) No. of Specimens	[7.98] (55.0) 3,870 5 0 [7.04] (48.5) 132,425 5 0 [6.57] (45.3) 987,695 4 0				

NOTES: 1. Stacking sequence (0, +45, -45, 0, 0, -45, +45, 0, 90, 0)_e
2. These specimens had a 0.1935 inch (0.491 cm) hole in the center of the test

section. Stresses calculated using not cross-sectional area.

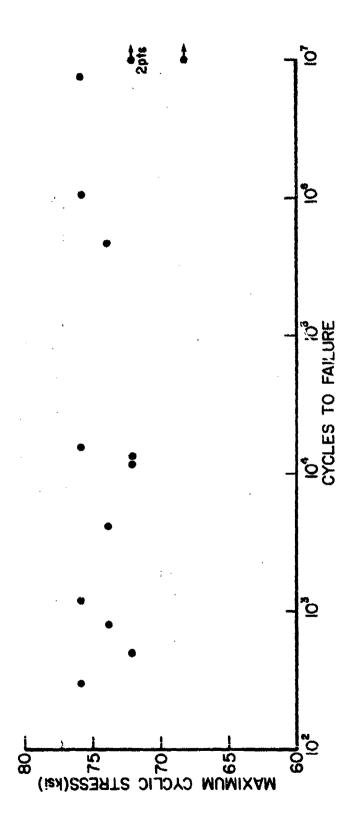
3. Patigue lifetimes are log mean values. All residual strengths determined. by tensile test at 72°F (22°C).

4. One specimen survived to 10⁷ cycles without failure.

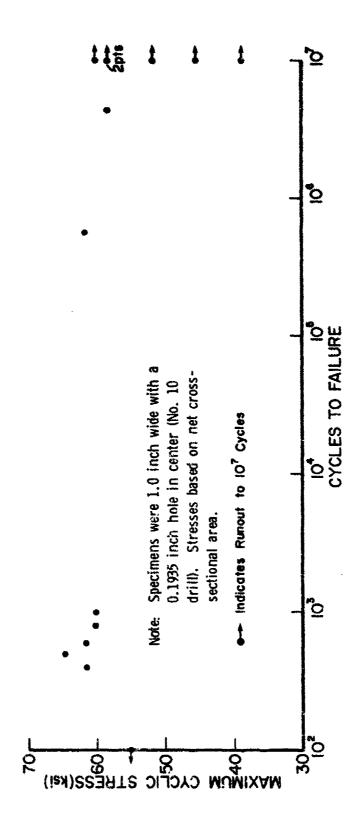


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Tensile-Tensile Fatigue Behavior of Bidirectional HyE 2034D Composite Laminates: $\pm 45^{\circ}$ Fiber Orientation, R = 0.10, 10 Hz. Figure 55.



Tensile-Tensile Fatigue Behavior of Multidirectional HyE 2034D Composite Laminates at 72°F (22°C): $(0.45,-45,0,0,-45,45,0,90,0)_S$ Fiber Orientation, R = 0.10, 10 Hz. 56. Figure



THE REPORT OF THE PROPERTY OF

Tensile-Tensile Fatigue Behavior of Multidirectional HyE 2034D Composite Laminates at 72°F (22°C): (0,45,-45,0,0,-45,45,0,90,0)g Fiber Orientation, R = 0.10, 10 Hz. Figure 57.

TABLE 45

THERMOPHYSICAL PROPERTIES OF HyE2034D COMPOSITE LAMINATES

<u></u>	Composite Material Properties					
Fiber - VSC-32 Hatrix - 934 Haxinum Temperature Rating - 350*P(177*C) Resin Content - 26.5% by vt. Piber Content - 65.7% by vol. Void Content - ~0 Thickness of each type specimen: Therm. Exp 40 ply Therm. Cond 40 ply Glass Trans 8 ply						
THERMOPHYSICAL PROPERTIES: 0°						
	Test Method					
Thermal Expansion ¹ $\alpha_{_{\mathbf{X}}}[\mu i n/i n^{-p}] (\mu c n/c m^{-c})$ $\alpha_{_{\mathbf{Y}}}[\mu i n/i n^{-p}] (\mu c n/c m^{-c})$					चन्त्र ²	
No. of Specimens per direction	3	3	3	3		
Specific Heat Cp[btu/lb*F](J/kg-*C)	(0,110)(460)	[0.202](846)	[0.642](2689)	[0.718](3010)	psc ³	
No. of Specimens Thermal Conductivity ¹	3	3	3	3		
k _z (btu-ft/ft ² -hr-°F) (W/m-°C) No. of Specimens	[0.52] (0.89) 3	[0.67] (1.16) 3	[0.89] (1.53) 3	[0.99] (1.70) 3	Comparative	
Glass Transition Temp. Dry (°F)(°C) Wet (°F)(°C)						
THERMOPHYSICAL PROPERTIES: +45°						
Thermal Expansion 1 α_{x} [pin/in-°F] (pcm/cm-°C)	F0:15 (-0.27	[-0.2 2] (-0.40)	HO.36] (-0.64	[-0.49](-0.89	TMA ²	
No. of Specimens per direction	3	3	3	3		
Thermal Conductivity ¹ k _z [btu-ft/ft ² -hr-°F) (W/m-°C) No. of Specimens	[0.55] (0.94) 3	(0.561 (0.96) 3	{0.57] (0.99} 3	[0.59] (1.01) 3	Comparative	

- NOTES:1. On the unidirectionally reinforced specimens, the x-direction is along the fiber axis, the y-direction is across the fiber axis, and the z-direction is through the thickness (identical to the y-direction). On ±45° bidirectionally reinforced specimens, the x and y directions are identical and oriented at 45° to either fiber direction, while the z-direction is through the thickness.
 - 2. Thermo-mechanical analysis.
 - 3. Differential scanning calorimetry.
 - 4. Dynamic mechanical analysis.

TABLE 46

PRELIMINARY ACCUMULATED DATA FOR HyE 2034D¹

ByE 2034D (75 million modulus pitch) tested by various companies under different cure cycle and testing procedures. All mechanical test values, except shear, are normalized to 60% fiber volume. All testing was performed at room temperature.

	Fiberite	TRW	Ryan	G.D. Convair ²	G.D. Convair ³
F _{fu} - Ksi	99	95	84	91/	85/
E _f - Msi	37	39	344	Make while while their	33/
F _{su} - Ksi	10	8	9	9/	7/
F _{tu} - Ksi	110	121	123	108/39	87/32
Et - Msi	46	43	47	44/15	46/15
F _{CU} - Ksi			54 ⁵		
E _c - Msi			38 ⁵		

¹All information in this table provided by FIBERITE.

²Cure cycle 1, (0°)₁₂/(0, 45, 90, 135)_s
Apply vacuum at R.T., heat at 3°F/minute to 250 ± 5°F, hold 30 minutes, apply 100 psig, hold an additional 30 minutes, heat at 3°F/minute to 275 ± 5°F. Hold six hours, cool to below 150°F at a rate not to exceed 5°F/minute under vacuum and 100 psig, debag and free stand postcure for 20 hours at 275 ± 5°F.

³Cure cycle 2, (0°)₁₂/(0, 45, 90, 135)_s
Apply vacuum at R.T., heat at 3°F/minute to 250 ± 5°F, hold 45 minutes, apply 100 psig, hold an additional 45 minutes, heat at 3°F/minute to 350 ± 5°F, hold two hours. Cool to below 150°F at a rate not to exceed 5°F/minute under vacuum and 100 psig.

⁴ May be in error due to deflectometer troubles.

⁵Celanese compression tests.

4.4 T300/V378A

This graphite/polyimide system is based on a resin matrix system developed by U.S. Polymeric.

Tables 47 through 59 present the data generated for this nominal 450°F (232°C) graphite/polyimide system. Figures 58 through 73 illustrate the stress-strain, fatigue, and creep behavior of the material as well as the effects of humidity aging upon selected composite properties.

Probably the most unusual characteristic of this system is the very noticeable odor of the prepreg. This arises from a volatile reactive constituent in the resin and not only is offensive to those working with the prepreg, but also results in an abbreviated out-life for the prepreg. When a sufficient amount of this volatile reactant has vaporized, good quality laminates can no longer be fabricated. The substantial differences between the HPLC analyses on new and old V378A prepreg presented in Appendix B (pages 279 and 280) illustrate the dramatic changes undergone by the resin system even in 0°F (-18°C) storage. The first five peaks in the HPLC are very significantly reduced on the old material, while the last three have disappeared completely.

TABLE 47

PROCESSING CONDITIONS FOR T300/V378A COMPOSITE LAMINATES

Composite Processing Information

Material System - V373A Fiber - T300 W/epoxy size

Matrix - V378A

Maximum Rated Temperature - 450°F(232°C)

Prepreg by -U.S. Polymeric

Gr/PI

Laminate Processing Schedule

Layup Procedure: The prepreg was stored in a closed wrapper at 0°F (-18°C). Prepreg was warmed to room temperature before removal from wrapper to prevent moisture condensation on prepreg. Plies were cut to desired size with razor knife and stacked in desired sequence (release paper-removed) from each ply). The stack was placed in the autoclave according to the layup system illustrated in Figure 58. The corprene edge dam serves to restrict fiber flow.

Cure Schedule: Apply full vacuum and 85 psi above bladder at room temperature. Heat to 175°F (80°C) at a rate of ~4°F/min. Vent vacuum at 175°F (180°C) and hold at temperature for 2 hours. Heat up to 355°F (180°C) at a rate of ~4°F/min. and hold at 355°F (180°C) for 4 hours. Reduce pressure to 10 psi then cool to below 150°F (66°C). Remove panel from autoclave and start postcure.

Postcure Schedule: Heat to 475°F (246°C) and hold for 4 hours. Increase temperature to 550°F (288°C) and hold for 1 hour. Cool panels to below 150°F (66°C) and remove.

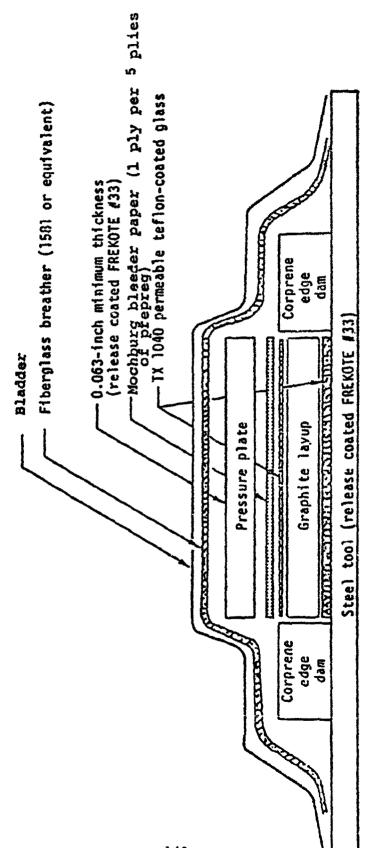


Figure 58. Layup System for V378A Laminates.

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TAPLE 48
PREPREG AND COMPOSITE PHYSICAL PROPERTIES

Material System - T300/V378A Piber - T300 Matrix - V	378A		Gr/Poly:	
Maximum Rated Temperature -	450°F(232°C	:) Pre	preg by -U.S.	Polymeric
Prepre	g Physical	Properties		
(Property)	(Stnd.Dev.)	(Range)	(Test Method)	(Ref.)
Volatile Content-5.5% by wt.	0.8%	4.6-6.1	QCI-C-V-14	Fiberite
Resin Content- 30.6% by wt.	1.8%	29.0-32.6	R-15	Fiberite
Gel Time - 32.2 min@210°F	0.3 min	32.0-32.5	G-2	Fiberite
No A Marketon Warren Same S. T.				
	e Physical	Properties ¹		WW. 7
	-	_	(Test Method)	(Ref.)
No. of Batches Involved- 1 Laminat No. of Panels- 36	-	_	(Test Method)	(Ref.)
Laminat No. of Panels- 36	(Stnd.Dev.)	(Range)		
Laminat No. of Panels- 36 Fiber Content-67.0% by wt.	(Stnd.Dev.)	(Range) 6.34-71.1%	see footwote	
No. of Panels- 36 Fiber Content- 67.0% by wt. Resin Content- 25.6% by wt. Void Content- 1.4 % by vol.	(Stnd.Dev.) 2.2% 2.2% 1.2%	(Range) 6.34-71.1%	see footnote	
Laminat No. of Panels- 36 Fiber Content- 67.0% by wt. Resin Content- 25.6% by wt. Void Content- 1.4 % by vol. Laminate Sp. Gr 1.58	(Stnd.Dev.) 2.2% 2.2% 1.2% 0.02	(Range) 6.34-71.1% 21.7-29.7% 0-4.3% 1.53-1.61	see footnote D 2734 D792	2
No. of Panels- 36 Piber Content- 67.0% by wt. Resin Content- 25.6% by wt. Void Content- 1.4 % by vol. Laminate Sp. Gr 1.58	(Stnd.Dev.) 2.2% 2.2% 1.2% 0.02	(Range) 6.34-71.1% 21.7-29.7% 0-4.3% 1.53-1.61	see footnote D 2734 D792	2 ASTM
No. of Panels- 36 Piber Content- 67.0% by wt. Resin Content- 25.6% by wt. Void Content- 1.4 % by vol. Laminate Sp. Gr 1.58	(Stnd.Dev.) 2.2% 2.2% 1.2% 0.02 As re	(Range) 6.34-71.1% 21.7-29.7% 0-4.3% 1.53-1.61 ported by managements by manageme	see footnote D 2734 D792	2 ASTM

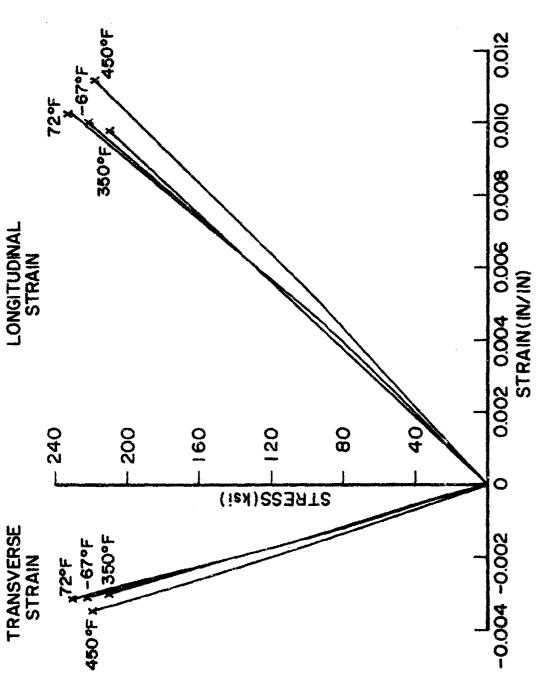
The properties reported here represent averages for all panels of this material used throughout the program.

²An acid digestion method similar to that described in AFML-TR-67-243 was used with the following materials and temperatures. A mixture of concentrated sulfuric acid and hydrogen peroxide (30%) in the ratio of 80% to 20% by volume respectively was used as the digesting acid. The specimens were soaked in this solution at 375-400°F (190-204°C) until the acid turned dark. The acid was drained, the specimen rinsed, and fresh acid added. This sequence was repeated until the acid did not discolor and the residual fiber weight reached equilibrium.

```
4.27 27
1
                                     HPLC ANALYSIS
                      HAO MOBILE PHASE 2_ DIPTARE
                      MOBILE PHASE 1____
                      FLOW RATE 1.0 Lan PROGRAM Meth C.
                      COLUMN(S) RF-0 (SP) DETECTOR Trace-UV
                      ATTENUATION 16 WAVE LENGTH 254
                      CHART SPEED ... FULL SCALE (mV) 40
                                10-2-00 OPERATOR B.
                          lamta storage at 000
             i.594
                                   TIME Com
                 Figure 59. HPLC Analysis of V378A.
                            142
.450 -- 4437
```

TABLE 49
TENSILE PROPERTIES OF T300/V378A COMPOSITE LAMINATES

	Composite Material Properties						
Material System - T300/V378A Frepres by - U.S. Polymeric Gr/PI Fiber - T300 Matrix - V378A							
Raminum Rated Temperature - 450°F(232°C) Resin Content - 25.60 by wt. Fiber Content - 67.16 by vol. How of panels from which specimens were tested							
	by vol.	in this tab	le - 7				
		CEMEZON: 0*					
	-67°F(-55°C)	72°F(22°C)	350°F(177°C)	450°F(332°C)			
ru (ksi](Pa)	[222.3] (1532)	(230.2] (1546)	(210.1) (1448)	[217-3] (1497)			
Stnd.Dev. [ksi] (19a) Range [ksi] (19a)	[31.7] (218) [172.4 - 250.0] (1186 - 1722)	[25.0] (172) [189.7 - 250.6]	[23.4] (161) [103.9 - 239.4]	[15.3] (105) [200.8-240.3] [1384 - 1556]			
No. of Specimens	5	(1307 - 1727) 5	(1267 - 1649) 5	2 (1.384 - 1838)			
Fepl [keil(Na)	[222.3] (1532)	[230.2] (1586)	(210.1) (1648)	(217.3] (1497)			
Stnd.Dev.[ksi](MPa) No. of Specimens	5 (218)	[25.0] (172) 5	[23.4] (161) 5	(15.3) (105)			
E [Heil] (GFa)	[20.0] (138)	(20.1] (138)	(22.1) (152)	[18.6] (130)			
Stud.Dev.(Mmi) (GPa) Mo. of Specimens	[0.6] (4.3) 5	[0.4] (3.1).	[1.5] (10)	[1.1] (8) 5			
Ex [pin/in] (pen/en)	10,130	10 -510	9,770	11,140			
Stnd.Dev. No. of Specimens	1,900	1,400	8.000 5	506			
ng.	0.31	0.30	0.33	0.12			
Stad. Dev. No. of Spacimens	0.02	0.03	9.03	5			
Test Hethod Reference		Straight-wided to ASTM 03039					
		TEMETON: 90°					
Py (kmi)(MPa)	[3.82] (40)	(5.37) (37)	[4.84] (33)	[4.21] (29)			
Stad. Dev. (keż.) (HPz) Rango	(0.91] (6.3) [4.68 - 6.60] (32 - 46)	(0.55) (3.8) [4.74 - 6.1] (33 - 42)	(0.36] (2.6) [4.02 - 4.97] (27 - 34)	[0.57] (3.9) [3.48 - 4.69] (24 - 32)			
No. of Specimens	5	5	5	5			
Fy (kmi) (HPa)	(5.82) (40)	(3.55) (24)	[3.42] (25)	[2.55] (18)			
Stnd.Dev.[ksi](HPa) No. of Specimens	[0.91] (6.3) 5	(0.94) (6.5) 5	(0-35) (2-4) 5	(0.44) (4.4)			
Ey (Heil) (GPa)	(L-40) (9.6)	[1.31] (9.0)	(1.07) (7.4)	(1.00) (6.9)			
Stud.Dev. (Mei) (GPs) No. of Specimens	(0.01) (0.07)	(0.03) (0.2)	(0.03) (0.2)	(0.02] (0.1)			
Ey [µin/in] (µcm/cm)	4,345	4,140	4,130	4.290			
Stud. Dev. No. of Specimens	600 5	410	390	630			
v _Y x	0.0221	0.0201	0.0161	0.0171			
Stnd. Dev. No. of Specirens							
Test Method Reference		Straight-side	9				
Commend using als	stic moduli and lo	ngitudinal Poisson	's ratio.				



Tensile Stress-Strain Curve for Unidirectional T300/V378A Composite Laminates: 0° Fiber Orientation. Figure 60.

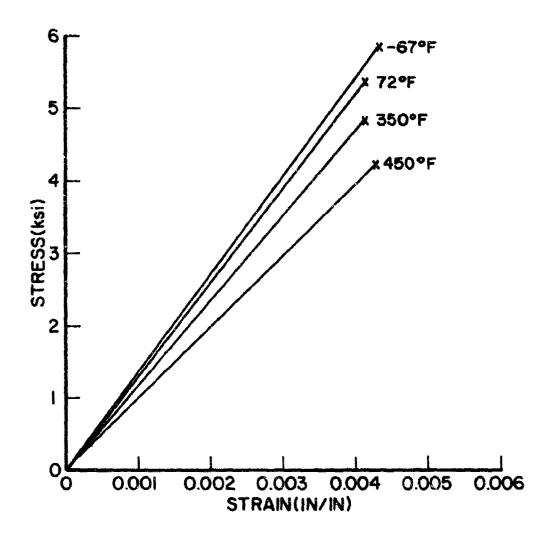


Figure 61. Tensile Stress-Strain Curves for Unidirectional T300/V378A Composite Laminates: 90° Fiber Crientation.

TABLE 50
TENSILE PROPERTIES OF T300/V378A COMPOSITE LAMINATES

Haterial System - T300, Fiber - T300 Hater Hacimum Rated Temperate Resin Content - 26.98 Fiber Content - 66.18 Void Content - 8.38 b	ix - V378A mrs - 450°F(232°C) by wt. by wel.	Nominal Ply No. of pane in this ts	. Gr 1.59 Thickness - 0.0052 ls from which spec	imens were tested			
TEMBLON: ±45°							
	-67°F(-55°C)	72°2 (22°C)	350°F(177°C)	450*F(232*C)			
rtu (ksi] (Ma)	(21.52] (148)	[21.29] (147)	[15.12] (111)	[14.94] (103)			
Stnd.Dav. [ksi] (MPa) Range [ksi] (MPa)	[1.17] (8.1) [20.33 - 23.12] (140 - 159)	[1.29] (8.9) [19.18-22.14] (132-153)	(0.69) (4.8) [14.96-16.77] (103-116)	[0.34] (2.3) [14.46 - 15.41] (100 - 106)			
No. of Specimens	5	5	5	5			
F ^{tpl} [ksi](Wa)	[8.32] (57)	[6.35] (44)	[4-49] (31)	[3.46] (24)			
Stnd.Dev. [ksi] (MPa) No. of Specimens	(0.83) (5.7) 5	[0.67] (4.6) 5	[0.59] (4-1) 5	[0.73] (5.0)			
Et [Hmi] (GPa)	[3.13] (22)	[2.96] (20)	[2.54] (18)	[2.16] (15)			
Stnd.Dev.[Hei](GPa) No. of Specimens	[0.16] (1.1) S	[0.03] (0.2) 5	[0.13] (0.9) 5	(0.11] (0.8)			
ε ^{tu} (μin/in)(μcm/cm)	9,020	12,100	27,070	20,320			
Stnd. Day.	930	1.40	11,020	230			
No. of Specimens	5	5	5	_ 5			
v ^e xy	0.70	0.59	1.00	0.82			
Stnd. Dev.	0.05	0.04	0.07	0.03			
No. of Specimens	5	j 5 ·	I. •	5			
Test Method Reference		Strai	ght~sided tension ASTM 03039				

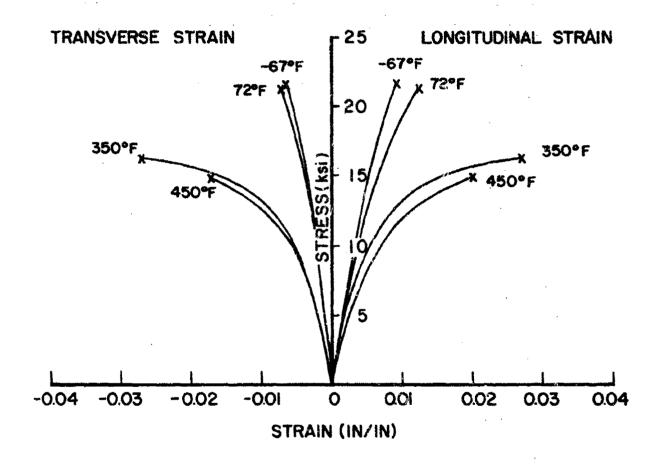


Figure 62. Tensile Stress-Strain Curves for Bidirectional T300/V378A Composite Laminates: +45° Fiber Orientation.

TABLE 51
TENSILE PROPERTIES OF T300/V378A COMPOSITE LAMINATES

Composite Material Properties						
Material System - T300 Fiber - T300 Maximum Rated Temperat Resin Content - 25.7% Fiber Content - 56.6% Wold Content - 1.8% by Thickness of each type	Matrix - V178A sure = 450°F(232°C) by wt. by wol.	Proprog by - U.S. Polymeric Gr/Polyimide Liminate Sp. Gr 1.57 Hominal Ply Thickness - 0.0053 inch (0.13 mm) No. of penels from which specimens were tested in this table - 13				
7781	-67°F(-55°C)	72°F(22°C)	350 T(£77 C)	450°\$(233°č)		
rtu (kail(PPa)	-07.57-35.07	(119.7) (825)	[106.1] (731)	[107-5] (741)		
Fi (ksi)(PPa) Stnd.Dev.(ksi)(PPa) Range (ksi)(PPa)		[12.8] (86) [102.6-130.4] (707 - 898)	[11.4] (79) [90.3 - 119.6] (622 - 824)	[12.1] (83) [88.9 - 119.2] (613 - 821)		
No. of Specimens		5	S	5		
P ^{tyl} (kmi) (kPa)		[119.7] (825)	(106.1) (731)	(107.5) (741) (12.1) (83)		
Stud.Cov. (kmi.) (1990) No. of Specimens		[12.8] (88) 5	[11.4] (79)	5		
E ^t (Mail (GPa)		[13.96] (96)	[13.41] (92)	(11.15) (91)		
Stnd.Dev.[Mai](GPs) No. of Speciment		(1.13) (7.8) S	(2.43) (16.7) 5	(0.80) (5.5) S		
E _N (pin/in) (pom/om)		10,590	9,020	9,380		
Stad.Dev. No. of Specianne		270 5	910 5	1,463 \$		
المار ال		0.59	0.62	0.52		
Stad. Dev. No. of Specimens		0.05 5	5	\$		
Test Hythod Jeferense		MF2M: D3038	•			
	30#: (0, +45, -45,	0, 0, -45, +45, 0	, 90, 0), with 0.	1935 inch(0.491 cm)		
y ^{tu} (kai) (NPa)		(93.1) (641)				
Stad.Dav. [kai.] (Ma) Range		[14.2] (98) [79.9-112.5] (551 - 775)				
No. of Specimens		\$				
F _y (kmi)(MPm) Stmi.Dev.[kmi](MPm)						
No. of Specimens						
Ey (Mai) (GPa)						
Stnd.Dev.[Mai] (GPa) No. of Specimens						
E (pin/in) (pen/em)						
Me. of Specimens						
"YR Stad Day. Me. of Specimons						
Test method Reference						

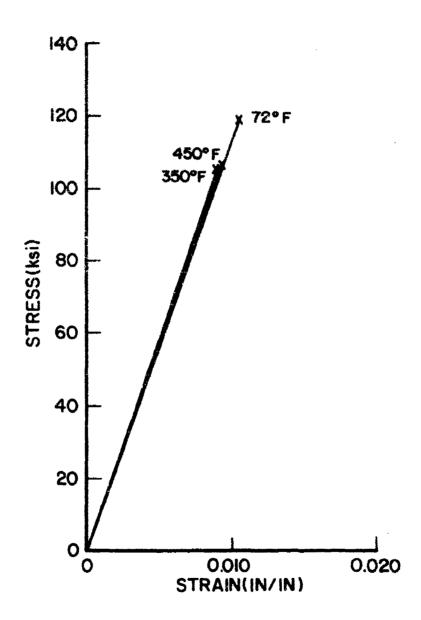


Figure 63. Tensile Stress-Strain Curves for Multidirectional T300/V378A Composite Laminates: (0,45,-45,0,0,-45,45,0,90,0)_S Fiber Orientation.

TABLE 52

COMPRESSIVE PROPERTIES OF T300/V378A COMPOSITE LAMINATES

	Composite	Material Properti	es	
Maximum Rated Temperatu Resin Content - 24.2% Fiber Content - 69.1%	x - V378A ure - 450°F(232°C) by wt. by vol. by vol.	Laminate Sp. Nominal Ply No. of panel in this tab	Thickness -0.0050 s from which speci le - 2	
	CON	Pression: 0°		
	-67*F(-55*C)	72°F(22°C)	35C*F(177*C)	450°F (232°C)
Px [ksi] (MPa)	[213.4] (1470)	[192.6] (1327)	(162.1) (1117)	[100.6] (693)
Stnd.Dev. [ksi] (MPa) Range [ksi] (MPa)	[17.9] (123) [189.7-238.1] (1307-1640) 5	[16.0] (110) [168.5-212.8] (1161-1466)	[22.4] (154) [36.8-195.0] [943-1344)	[26.4] (182) [79.4 - 145.9] (547 - 1003)
No. of Specimens	3	3		
FCPl [ksi] (MPa)	[45.3] (312)	[140.0] (965)	[123.3] (850)	[85.5] (589)
Stnd.Dev.[ksi](MPa) No. of Specimens	(15.0) (103) 5	[83.3] (574) 5	[50.5] (348) 5	[44.6] (307) 5
EC [Mai] (CPa)	[19.6] (135)	[19.8] (136)	[23.4] (161)	[20-8] (143)
Stnd.Dev.[Msi](CPa) No. of Specimens	(1.7) (12) 5	[0. 6] (4)	(1.4] (10) 5	(2.3) (16)
ε ^{cu} (μin/in](μcm/cm)	12,940+ ¹ , ²	16,120+1,3	8,120	5,140
Stnd. Dev. No. of Specimens	5,490 5	3,170 5	2,760 5	1,530
Test Method Reference		ASTN D3	410	
	CON	@RESSION: 90"		
F ^{CQ} [ksi](MPa)	[37.9] (261)	(26.8) (185)	[19.0] (131)	(20.2) (139)
Stnd.Dev. [ksi] (MPa) Range No. of Specimens	[11.6] (80) [28.2-54.7] (194-377)	[2.1] (14) [24.4-28.5] (168-196) 5	[2.1] (14) [16.2-21.8] (112-150)	[3.2] (22) [17.6 - 25.5] (121 - 155) S
-				
ropl [ksi](MPa)	(16.1) (111)	[5.9] (41)	[5.2] (36)	[6.8] (47)
Stnd.Dev. [ksi] (MPa) No. of Specimens	{13.2} (91) \$	[2.3] (16) 5	(1.5) (10)	5
E _y [Msi](@a)	[2.5] (17)	[2.5] (17)	(1.6) (11)	[1.2] (8)
Stnd.Dev.[Msi](GPa) No. of Specimens	[1.0] (7) 5	(0.9) (6) 5	[0.3] (2)	[0.1] (1) 5
εy [µin/in] (µcm/cm)	23,360+1,3	23,820+1,4	13,820+1,2	18,880+ ¹ , ⁵ 16,870
Stnd. Dev. No. of Specimens	7.170 5	7,820 5	4,260	5
Test Method		ASTM D3	410	

Ultimate strain values represent maximum observed strain rather than ultimate values.

Three of five specimens exhibited evidence of buckling.

One of five specimens exhibited evidence of buckling.

All five specimens exhibited evidence of buckling.

Two of five specimens exhibited evidence of buckling.

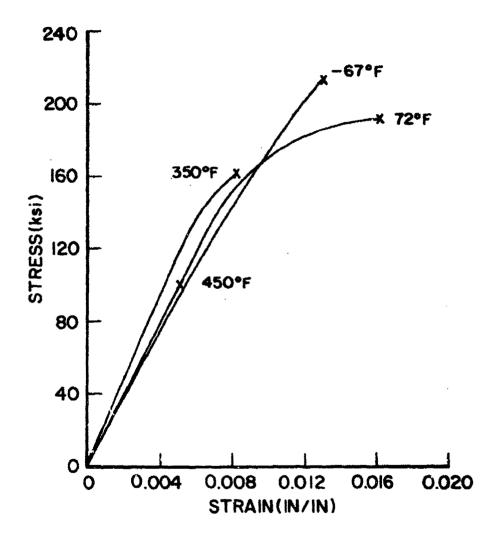


Figure 64. Compressive Stress-Strain Curves for Unidirectional T300/V378A Composite Laminates: 0° Fiber Orientation.

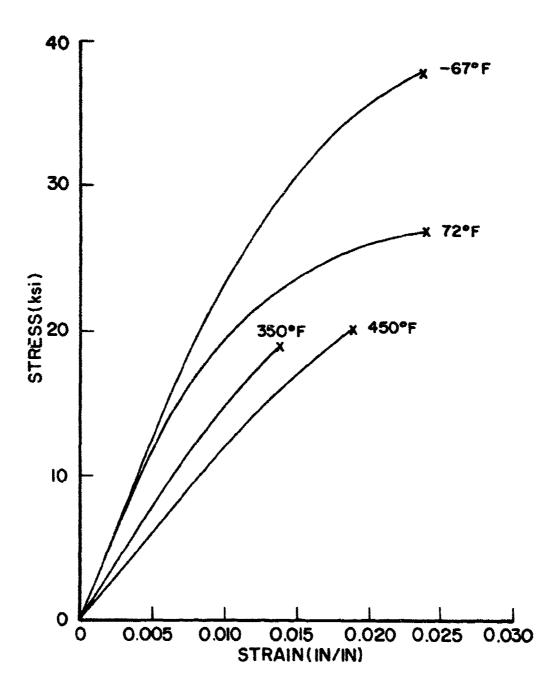


Figure 65. Compressive Stress-Strain Curves for Unidirectional T300/V378A Composite Laminates: 90° Fiber Orientation.

TABLE 53
PLEXURAL PROPERTIES OF T300/V378A COMPOSITE LAMINATES

more and the last the

	Composite	Material Propertie	: \$	
Maximum Sated Temperat Remin Content - 23-24 Fiber Content - 69-04	ris - V378A ture - 450°F(232°C) by wt. by wol. by wol.	Laminate Sp. Mominal Ply 1 No. of panels in this tabl	hickness - 0.0054 from which specis a - 2	inch (0.14 am)
	1	LEXURE: 0°		
	-57°\$ (-55°C)	72°F(22°C)	350°F(177°C)	450°F(232°C)
ria (ksi] (Ma)	[270.7] (1865) ¹	[224.6] (1547) ²	[170.5](1175) ³	(164.1) (1131)4
Stud-Dev. (kei] (MPa) Range [kei] (MPa)	(15.8] (109) [248-4-289.4] (1711-1994)	[5.2] (36) [219.5~232.3] (1512~1601)	[6.3] (43) [163.4-175.4] (1126-1209)	[9.5] (65) [156.5-176.1] [1078-1213]
No. of Specimens	3	3	•	1
E ^f [Mai] (GPa)	(16.0] (110)	(17.2) (119)	[15.6] (107)	(16.1] (111)
Stnd.Dev.[Hsi](GPa) No. of Specimens	(0.7] (5) 5	[1.2] (8) 5	(0.6) (4) 3	[0-6] (4)
Tast Method Reference		4 pt. flemma 3 pt. flemma 3 pt. flemma ped Composite Design Guide; Jan., 1971 ⁵		
		LEXURE: 90°		
Pru [ksi](Ma)	[11.18] (77.0)	[11.58] (79.8)	[8.39] (57.8)	[7.84] (54.0)
y Stnd.Dav. [ksi] (MPa) Range [ksi] (MPa)	[2.12] (14.6) (9.40 - 14.38) (64.8 - 99.1)	[0.91] (6.3) [10.33 - 12.35] [71.2 - 85.1]	[1.19] (8.2) [6.92 - 9.80] (47.7 - 67.5)	[0.54] (3.7) [7.07 - 8.52] (48.7 - 58.7)
No. of Specimens	5	5	5	5
E (Mail(GPa)	[1.82] (12.5)	(1.74) (12.0)	(1.47) (10-1)	[1.29] (8.9)
Stnd.Dev.[Mei](cma) No. of Specimens	[0.11] (0.8) 5	[0.05] (0.3)	[0.06] (0.4) S	[0.07] (0.4) 5
Test Method Reference	Adva	4 pt. flexure nond Composite Des	iga Guide; Jan., l	971 ⁵

NOTES: 1. All failures were in tension on lowest ply.

SENSON ---

2. Mixed failure mode. Some delemination, some tension on bottom ply,

. some compressive under upper loading nose.

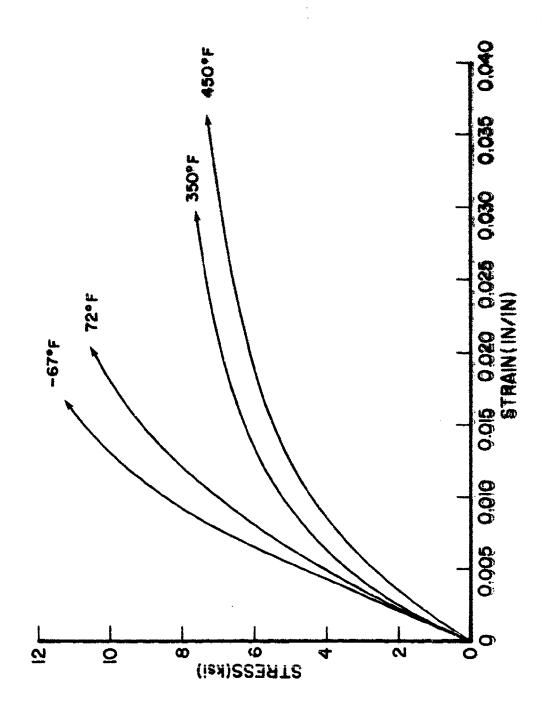
 Mined failure mode. Some tensile failure on bottom ply and some compressive failure on top ply. Two other specimens were tested in 4-point flammre but exhibited shear failures at a flammral stress level of 161.5 kmi (1113 MPa).

4. Two specimens exhibited sees mixed failure mode as those tested at 350°F(177°C). Three specimens exhibited only compressive failures on two play.

 This procedure curresponds to ASTM D790 except for loading speed and, in the case of the 4-point test, the position of the two upper loading points.

TABLE 54
SHEAR PROPERTIES OF T300/V378A COMPOSITE LAMINATES

		e Material Propert		
Material System - T300 Fiber - T300 Mater Maximum Rated Temperat Resin Content - 25.7% Fiber Content - 66.3% Void Content - 0.8% by Thickness of each type	rix - V378A rure - 450°F (232°F) by wt. by wol. vol.	Nominal Ply No. of pane in this ta	Thickness - 0.00 lis from which spe	cisens were tests
	n	PLANE SHEAR		
	-67** (-55°C)	72*F(22*C)	350°F(177°C)	450°F(232°C)
P ^{SU} (ksi] (MPa)	[10.76] (74.1)	(10.64) (73.3)	[8.06] (55.5)	[7.47] (51.5)
Stnd.Dev. (ksi] (MPa) Ranga [ksi] (MPa)	[0.59] (4.1) [10.17 - 11.56] (70.1 - 79.6)	[0.61] (4.2) [9.59 - 11.07] (66.1 - 76.3)	[0.34] (2.3) [7.48 - 8.39] (51.5 - 57.8)	(0.17] (1.2) [7.23 ~ 7.70] (49.8 ~ 53.1)
No. of Specimens	5	5	5	5
Ca [Her] (GBs)	[1.86] (12.8)	[1.62] (11.2)	[1.34] (9.2)	[1.15] (7.9)
Stnd.Dev.[Mgi] (GPa) No. of Specimens	[0.06] (0.4) 5	(0.05) (0.3) 5	[0.12] (0.8) 5	(0.11) (0.8)
Test Hethod Reference	J. Comp. Htl	<u>+</u> 45° Straight- s. [Vol. 6, p. 25;	-sided tension 2 & Vol. 7, p. 12	· 6}
	3618	FLANDIAR SHEAR		
pists [ksi](NPa) Stnd.Dev.[ksi](NPa) Range No. of Specimens	[18.14] (125) [0.63] (4.3) [17.30-18.88] (119-130)	[15.02] (103) [0.49] (3.4) [14.23-15.56] (98-107)	[10.02] (69) [0.62] (4.3) [9.03-10.75] (62-74)	{9.24} (64) {0.17] (1.2) {8.96-9.43} (62-65)
Test Nethod Reference			5 DK D2344	5



Inplane Shear Stress-Strain Curves for 1300/V378A Composite Laminates. Figure 66.

The second secon

TABLE 55

TENSILE, COMPRESSIVE, AND SHEAR PROPERTIES OF T300/V378A COMPOSITE LAMINATES

				Composite Names	Composite Managerial Properties				
System	3.78A	Prepres by	- U.S. Poly.	14/25		8	PRESTOR IN	11	
Fiber 7300 Matrix - 0378A	43/EA	Lesinate Sp	Leminate Sp. Gr 1.58			W. E. 12 12.	15.12.17.17.17.03		13.77113.63
MAXIMUM Reted Temperature - 450°F	450°F	Mominal Ply	Thickness 0	.005 fnch (0.13cm	Hominal Ply Thickness -0.005 inch (0.13cm) Exposure This (hre)	17.5	17.5	2471 \$	3434
Fibrr Centent - 56.98 by vol.	wc. vol.	were tested	MO. Of panels from which apachmons were tested in this table - 1	Specimens :	Mt. Gain(* of orig. i dry wt.)	0.69	6.11	7.7	1,36
"aid Content - 0.8% by vol.			tions - 160°F	Aging Conditions - 160°F & 95-100% R.H.	Stad. Dev. (%)	0.04	60.03	0.03	4
Interness of each type specimen:	yecimen: Te Sh	ension - 15 pl hear - 15 ply	nsion -15 ply: Compr 20 ply: ear - 15 ply	do piyr	No. of Specimens	vs.	· vn		7 P
	TENTE TON	900			egu (keil (MPa)	(74.20)(16)	[18.33)(126)	(25.33) (175) (19.37) (133)	119.37] (1333)
	T Carry T				Stud. Dev. (kg1) (spa)	_	11 201 1151		
-	72**(22 °C)	350*F(177*C)]72*F(22*C	72*F(22°C)	350*F(177°C)	Range	[21.17-26.99]	_		(2.25) (15)
ANDORGE TARE (NTE)	97	18	25883	25883		(146 - 186)			[16.91-21.97]
dry at.)	0.78	0.79	1.76	1.73	No. of Specimens	un.	uh.	(181 + 691)	(117 - 157)
Strd. Dev. (4)	0.03	0.04	0.01	90	rcpi.			_	
No. of Specimens	'n	1 50	in	<u></u>	(All (Mari)		(2.36)(16.3)	(4.33)(16.9)	[3.20](22.0)
Ftu (Peri Japanie Schieb a)	561130 31	(3 031 (36 4)			Stnd. Dev. [ksi] (MPa)	(0.18] (1)	(1.68) (12)	(4) [16.0]	(0.00) (6)
	18.661100	1 . 02.11.0.01	(3.90)(26.9)	10.79](5.4)	No. of Specimens	5	40		4
Dev.	.801(5.5)	(6.863(5.9)	(0.24)(1.6)	(0.11)(0.8)				_	n
(KET) (MET)	(4.66-6.60)	[2.62-4.81]	[3.58-4.22]	(0.59-0.861	*y (GPA)		(1.60)(11.0)	(5.42) (16.9)	12.571(15.7)
)	(32,1-45,4)	(18.1-33.1)	(24.7-29.1)	(4.1-5.9)	Strd. Dev. [Ms1] (GPa)	(0.381 (3)	(6.41) (3)	[0.45] (3)	[I.09! (8)
	n	vo	so	'n	No. of Specimens	'n	<u>د</u>	'n	
Ftp1 (MB41) (MB4) (4.63) (27.8)	(63) (27.8)	(0.94) (6.5)	(3.59)(24.7)	(0.52) (3.6)	con [uin/in] (ucm/cm)	31,800	39.600\$	31 7003	9010 01
Etnd. Dev. [k#1] (NPa)[(1.07] (7.4)	.07] (7.4)	(0.421(2.9)	40.23171 A1		,			00/17	00000
No. of Specimens	· ••		5	6:31[67:01	No. of Specimens	09 7 (8	-	~	010'6
E. [Ast] (CDs 1/(1, 3) / (9, 0)	311/19.03	71 00177 81							
,		1 1.09 3 (7.5)	(0.6)176.77	[0.94](6.4)	Test Method		A CANA	. D3410	
Ernd. Dev. [Nat.] (CPa)(0.05)(0.3)		[0.08] (0.6)	0.021(0.1)	(0.19)(2.3)	Keleronce			- 3	
see or specimens	'n		s	ı,		INT'EX	EXLANTINA SHEAR		
tetu [uin/in] (uon/cm)	4460	3760	2970	840	Exposure Time (hru)		<48 ²	136	12#
Strd. Dev.	1040	710	200	910	dry we.	0.14	0.72	7.50	1,24
No. of Specimens	vo.	'n	5	2.5	Stnd. Dev. (4)	0.12	50.0	5	;
Test: Mathod					No. of Specimens	10	'n	101	, s
Kethrence		ASTM D3039	-		risu [ksi] (MPa)	(ke1) (MPa) [13.991(96)	(4,9) (6)		
					Stnd. Dev. [kgl] (MPa)	[ksi](Mpa) [0.29] (2.0)	(0.76) (5.2)	10.391 (2.7)	(2.4) (2.4)
						(63 - 68)	(54 - 57)	(17.59-15.04)	(7.04-8.14)
				B Military	No. of apecimens	ın.		10	600 S
					Test Method		3404	ALCTO MINOR	
**************************************		A confirmation of the second			ROT Grande		utor		-

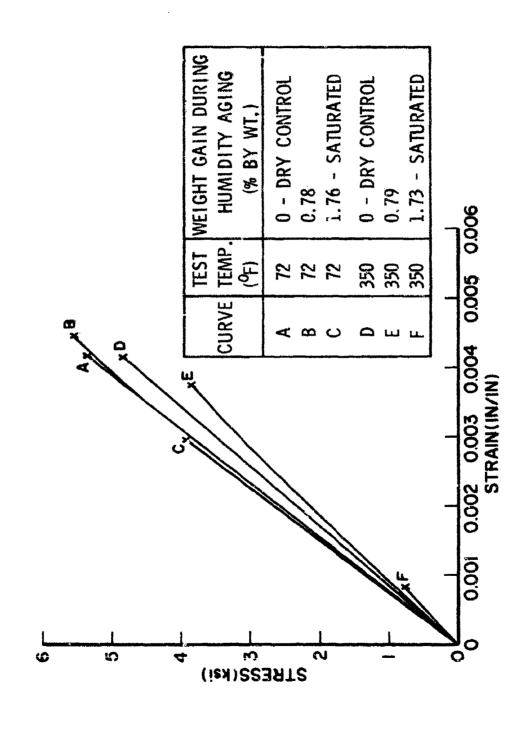
look saturation at aging conditions.

Specimens gained weight so rapidly that they were already saturated at first weighing (48 hrs). They were dried in a dessirator at 72°F and 0% R.H. for 116 hrs to zeach the weight gain indicated.

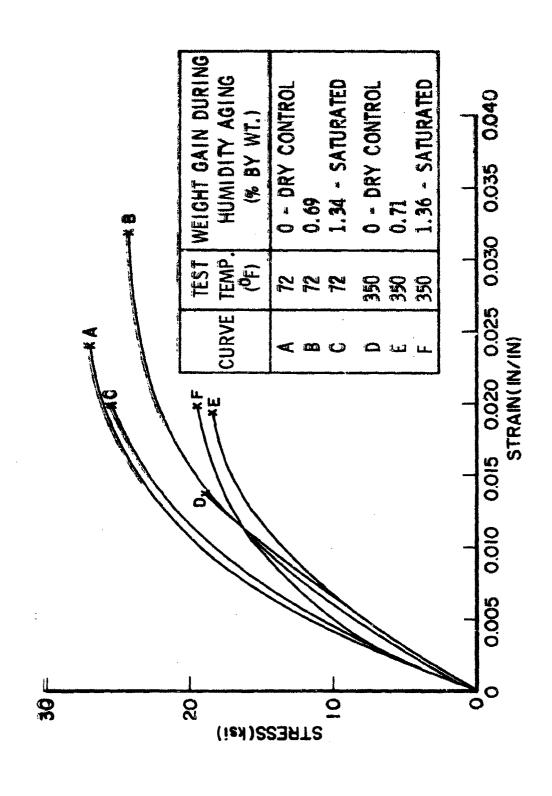
Specimen at acached saturation long before this but were kept in humidity cabinet until test schedule permitted testing.

Three specimens tested after five minutes in 350°F oven, giving average strength of 20.95 ksi (144 Mps). Two specimens were tested after 10 minutes in 350°F oven, giving average strength of 17.00 ksi (117 Mps).

Three of the five specimens exhibited evidence of buckling.



Tensile Stress-Strain Curves for Unidirectional T300/V378A Composite Laminates After Humidity Aging at 160°F (71°C) and 100° R.H.: 90° Fiber Orientation. Figure 67.



Compressive Stress-Strain Curves for Unidirectional T300/V378A Composite Laminates After Humidity Aging at 160°F (71°C) and 100% R.H.: 90°F Fiber Orientation. . 68 Figure

TABLE 56 CREEP PROPERTIES OF T300/V378A COMPOSITE LAMINATES

		te Material Properties	
Piber - T3 Meximum Tom Regin Conte Piber Conte Void Conten Test Method			-0.0052 inch(0.11 mm ch specimens were - 18 specimen:
		chesp.	
Temperature		(0,+45,-45,0,0,-45,+45,0,90,0).	+45*
72** (22*C)	Streen Lavel (kgi](MPc) Crosp Strain, 500 hr(s) No. of Sperimens Resident Street/th(kgi](MPn) No. of Sperimens	(101.8) (701) 0.0149 1	[16.93] (117) 0.3575 \$ 24 hzs ¹ 3
	Strang Lovel (hail Offe) Croep Strain, 500 hr(%) No. of Specimene Residual Strangth(ksil (Mfm) No. of Specimens	(95.2)- (656) 0.0197 3 	(14.90) (103) 0.6011 3
	Stream Lavel (tai) (SPm) Creep Strain, 500 br(4) No. of Specimens Resident Strongth(hai) (SPm) No. of Specimens	(41.3] (559) 0.0163 3 	(12.77) (89) 0.3748 3
354°F(177°C)	Streen Lovel (Ini) (1874) Cross Strain, 500 hg(%) No. of Systians. Revident Streegth(Ini) (1874) Po. of Specimen.	(84.91 (583) 0.0366 2 	(12.80) (46) 1.8756 2. 3
	Streme Level (kmi) (sSe) Group Strain, SCS hr (4) No. of Specimus Renidual strength(kmi) (sSe) No. of Specimus.	676.11: (512) 0_3140 3	(11.28) (78) 0.9706 ² 2
	States Level (kei](HPe) Crosp Strain, 500 hr(%) No. of Speciarus Ponidoni Stramyth[kei](HPe) No. of Speciarus		(9-67) (67) 0.7073 ² 2 3
50°F(232°C)	Strans Lovel (Rei (194) Comp Strain, 500 hr(t) No. of Specimens Incident Strangth(Rei) (194) No. of Specimens	·	[31.96] (62) — —
	Streem 'avel (kmi) (MPa) Crosp Stanin, 500 hr(%) No. of Specimens Nonichal Strength(kmi) (MPa) No. of Specimens		(10.45) (72) 0.4713 1 3
	Strage Level (Mil) (1941) Croop Strain, 500 hr(4) No. of Specimens Beatdenl Strangth(kmi) (1941) No. of Specimen		

Strain gaps inited on one specimen after 24 hrs., on esector after 144 hrs. One specimen failed during test.

²Strain gage failed on one specime during test.

Two specimens failed or loading. Strain gage failed on two specimens during test.

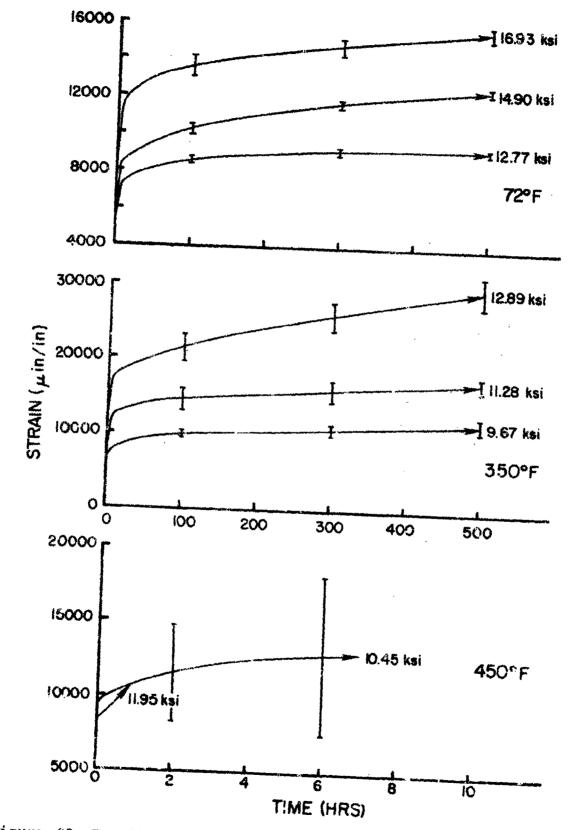


Figure 69. Tensile-Creep Behavior of Bidirectional T300/V378A Composite Laminates: +45° Fiber Orientation.

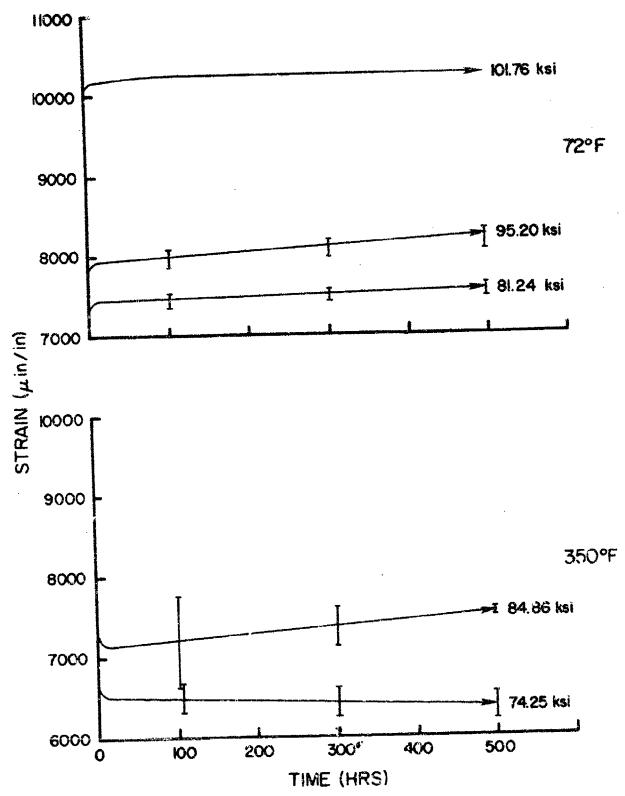


Figure 70. Tensile-Creep Behavior of T300/V378A Composite Laminates: (0,+45,-45,0,0,-45,+45,0,90,0)_S Fiber Orientation.

TABLE 57

STRESS RUPTURE PROPERTIES OF T300/V378A COMPOSITE LAMINATES

	Composite Material	Properties	
Fiber - T30 Hamimum Temm Resin Conte Fiber Conte Void Content Test Method	stom - T300/V378A 0 Hatrix - V378A parature Rating - 450°F st - 26.0% by wt. st - 66.8% by vol. t - 1.2% by vol. -Straight-sided tension ASTM D2290 and D3039	Fragrag by -U.S. Polymeric Laminate Sp. Gr 1.58 Nominal Ply Thickness -0.005 No. of panels from which spe were tested in this table - Thickness of each type speci (0/+45/90) - 20 ply +45 - 8 ply	cimens 16
	STREES MUT	rota	
Temperature	Fiber Orientation	(0,+45,-45,0,0,-45,+45,0,90,0),	±45°
72°F (22°C)	Streen Level[ksi](NPa) Time to Failure(hrs) No. of Specimens Residual Strength(ksi](NPa) No. of Specimens Streen Level(ksi](NPa) Time to Failure(hrs) No. of Specimens Nerichal Strength(ksi](NPa) No. of Specimens	1 [95.2] (656) 503+	[16.93] (117 3632 3
260°F(127°C)	Etrees Leval(ksi)(NMa) Time to Failure(hra) No. of Specimens Residual Strength(ksi)(NMa) No. of Specimens Strees Leval(ksi)(NMa) Time to Failure(hra) No. of Specimens Residual Strength(ksi)(NMa) No. of Specimens	2 [74.3] (512) 507+3 3	[12.89] (89) 5024-J 3
350°F (177°C)	Stress Level(kui)(MFa) Time to Failure(hrs) No. of Specimens Residual Strength(ksi)(MFa) No. of Specimens Stress Level(ksi)(MFa) Time to Failure(hrs) No. of Specimens Residual Strength(ksi)(MFa) No. of Specimens		[11.95] (82) 230 32 1 [10.45] (72) 50343

loss species survived for 500 hours without failure.

Two specimens survived for 500 hours without failure. There specimens survived for 500 hours without failure.

TABLE 58 FATIGUE PROPERTIES OF T300/V378A COMPOSITE LAMINATES

	Composite M	aterial Propertie	s	
Fiber - T300 Maximum Tompo Resim Content Fiber Content Void Content Tost Mathod	Matrix - V378a eraturo Rating - 450°F(232°C) E - 25.8% by wt. E - 66.7% by wol.	No. of panels in this tabl Thickness of	Gr 1.57 hickness - 0.005 from which spec	imens were tested
	TENSILE	FATIGUE, R=0.1 ⁽³)	
Temperature	Fiber Orientation	<u>+</u> 45°	0/±45/90(1)	0/+45/90(1,2)
72°F (22°C)	Hax. Stress(ksi](MPa) Lifetime (cycles) No. of Specimens Residual Strength[ksi](MPa) No. of Specimens Max. Stress[ksi](MPa) Lifetime (cycles) No. of Specimens Residual Strength[ksi](MPa) No. of Specimens Max. Stress[ksi](MPa) Lifetime (cycles) No. of Specimens Residual Strength[ksi](MPa) No. of Specimens Residual Strength[ksi](MPa) No. of Specimens	[15.97] (110) 16,742 5 0 [14.90] (103) 68,856 4 0 [13.84] (95) 429,359 5	[95.8] (660) 15,534 5 0 [92.8] (639) 255,077#4.5) 4 1 [89.8] (619] 1,579,910+(4) 4	[83-8] (577) 61,300 1 0 [79-1] (545) 467,807
350°¥ (177°C)	Max. Stress [ksi] (MPa) Lifetime (Gycles) No. of Specimens Residual Strength [ksi] (MPa) No. of Specimens Max. Stress [ksi] (MPa) Lifetime (Gycles) No. oz Specimens Residual Strength [ksi] (MPa) No. of Specimens Max. Stress [ksi] (MPa) Lifetime (Gycles) No. of Specimens Residual Strength [ksi] (MPa) Lifetime (Gycles) No. of Specimens Residual Strength [ksi] (MPa) No. of Specimens	(13.70] (94) 4,727 5 0 (12.90] (89) 52,012 4 0 (12.09] (83) 347,393 5	[90.1] (621) 96.587 5 0 [87.5] (603) 323,176+(6) 3 0 [84.8] (584) 531.563 5	

Stacking sequence (0.+45,-45,0,0,-45,+45,0,90.0) ...

These spectmens had a 0.1935 inch (0.491 cm) hole in the captur of the test section. Stresses calculated using net cross-sectional area.

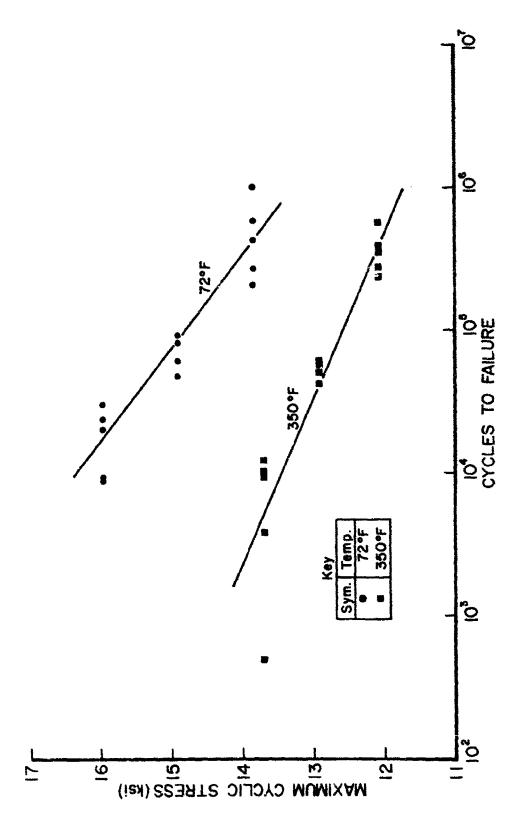
Fatigue lifetimes are log mean values. All residual strengths determined by tensils

tast at 72°F (22°C).

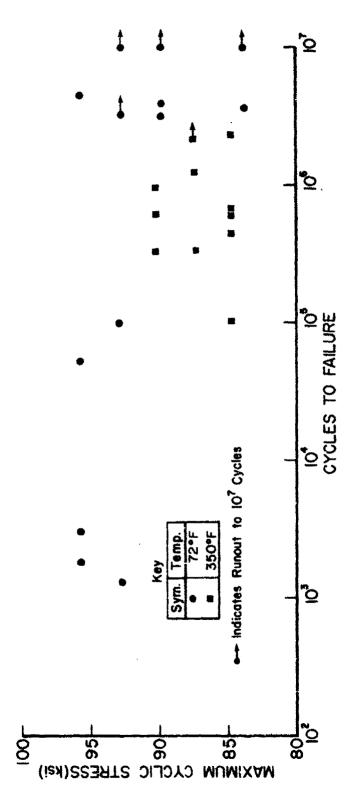
4. One specimen ran out to 10° cycles without failure.

5. One specimen broke at 1,269,500 cycles due to power outage.

^{6.} One specimen failed at 2,128,300 cycles due to oven overheating.



Tensile-Tensile Fatigue Behavior of T300/V378A Composite Laminates: ±45° Fiber Orientation, R = 0.10, 10 Hz. Figure 71.

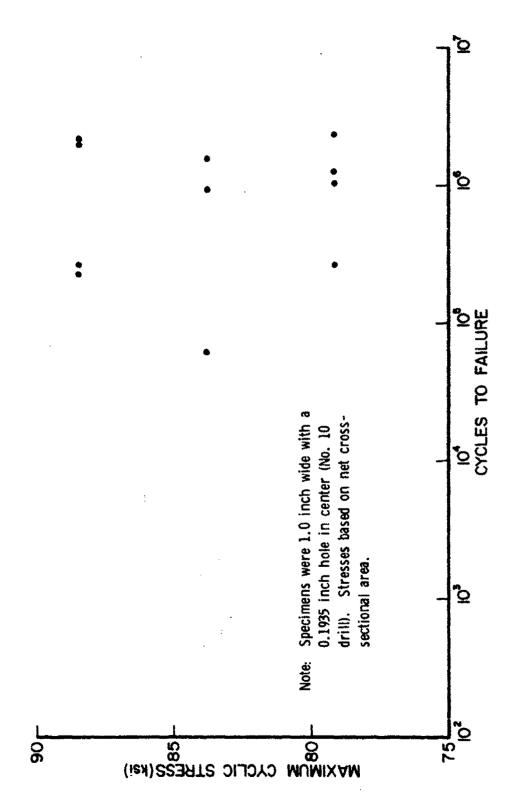


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Tensile-Tensile Fatigue Behavior of T300/V378A Composite Laminates: (0,45,-45,0,0,-45,45,0,90,0) g Fiber Orientation, R = 0.10, 10 Hz. Figure 72.

大学 大学 (1985年) 大学 (1985年) 大学 (1985年) (1985年)



Tensile-Tensile Fatigue Behavior of T300/V378A Composite Laminates: (0,45,-45,0,0,-45,45,0,90,0) g Fiber Orientation, R = 0.10, 10 Hz. 73. Figure

TABLE 59
THERMOPHYSICAL PROPERTIES OF T300/V378A COMPOSITE LAMINATES

	Compos	ite Material	Properties		· · · · · · · · · · · · · · · · · · ·
Material System - T300/V37 Fiber - T300 Natrial Maximum Temperature Rating Resin Content - 24.64 by Fiber Content - 67.24 by Void Content - 2.04 by W Thickness of each type spe	t - V378A y - 450°F(23 wt. vol. ol. cimen: Ther	2°C) Lami Aver Mo.	of panels fro this table - ply S	- 1.57 ness - 0.0051 m which speci	
	TEERMOP	HYSICAL PROPE	RTIES: 0*		
	-67°\$(-55°C)	72°R(22°C)	350°F(177°C)	450°F (232°C)	Test Method
Thermal Expension 1 a_{\text{pin/in-"F] (pen/cs-"C)} a_{\text{pin/in-"F] (pen/cs-"C)} so. of Specimens per direction					TA ²
Specific Heat Cp[btu/lb*F](J/kg-*C) No. of Specimens	(0.123) (515) 3	(0.206) (862) 3	(0-748] (3132) 3	[0-761] (31 86 3	°csc
Thermal Conductivity! k _z [btu-ft/ft ² -hr-*F] (W/m-*C) No. of Specimens	[0.28] (0.50) 3	[0.34] (0.59) 3	[0.44] (0.77) 3	(0.47) (0.83) 3	
Glass Transition Temp. Dry [*F](*C) Het [*F](*C)	[702] (37; [702] (37;				DMA ⁴
	THENCH	TRICAL PROPER	₹1131 ±45*		
Thermal Expansion 1 $\alpha_g[\text{uin/in-°F}]$ (ucm/cm-°C) No. of Specimens per direction	(2-21) (3-98) 3	[1.65] (2.97) 3	(2.11](3.79) 3	(2.06) (3.71) 3	THA ²
Thermal Conductivity! k_{z}[btu-ft/ft^2-hr-"F] (W/m-"C) No. of Specimens	[0.25] (0.44) 3	(0.29) (0.51) 3	[0.39] (0.67) 3	[0-42] (0-72) 3	Comparative

- NOTES:1. On the unidirectionally reinforced specimens, the x-direction is along the fiber axis, the y-direction is across the fiber axis, and the z-direction is through the thickness (identical to the y-direction). On +45° bidirectionally reinforced specimens, the x and y directions are identical and oriented at 45° to either fiber direction, while the z-direction is through the thickness.
 - 2. Thermo-Machanical Analysis
 - 3. Differential Scanning Calorimetry
 - 4. Dynamic Machanical Analysis
 - Gained wt. very rapidly. May have dried very rapidly also, so actual value was for dry material by end of test.

4.5 HyE 1076J

This system consists of 15,000 filament tow Thornel 300 from Union Carbide in Fiberite's 976 epoxy resin matrix.

Tables 60 through 74 present the data generated for this 350°F (177°C) graphite/epoxy composite material. Figures 74 through 89 illustrate the stress-strain, fatigue, and creep behavior of this material as well as the effects of humidity aging upon selected composite materials.

The 976 resin system was developed to retain higher property levels after humidity aging than earlier 350°F (177°C) epoxy systems. Two tables released by Fiberite are included at the end of this section which provides comparisons of the 934 and 976 systems.

TABLE 60

PROCESSING CONDITIONS FOR HYE 1076J COMPOSITE LAMINATES

Composite Processing Information Material System - RyE 1076J Fiber - T300/15K Matrix - 976 Maximum Rated Temperature - 350°F(177°C) Prepreg by - Fiberite

Laminate Processing Schedule

Layup Procedure: The prepreg was stored in a closed wrapper at 0°F (-18°C). Prepreg was warmed to room temperature before removal from wrapper to prevent moisture condensation on prepreg. Plies were cut to desired size with razor knife and stacked in desired sequence (release paper removed from each ply). The stack was placed in the autoclave according to the layup system illustrated in Figure 74. The corprene edge dam serves to restrict fiber flow.

Cure Schedule: Apply full vacuum and hold for 1/2 hour at room temperature. Heat to 250°F (121°C) at a rate of 2-5°F/min. When temperature has reached 250°F (121°C) apply 100 psi above bladder (while retaining vacuum). Hold at 250°F (121°C) for 45 minutes then heat to 350°F (177°C) at a rate of 2-5°F/min. Hold at 350°F (177°C) for 2 hours then cool to 150°F (66°C) at 2-5°F/min. Release pressure when temperature has reached 150°F (66°C), then release vacuum and remove panel from autoclave.

Postcure Schedule: None.

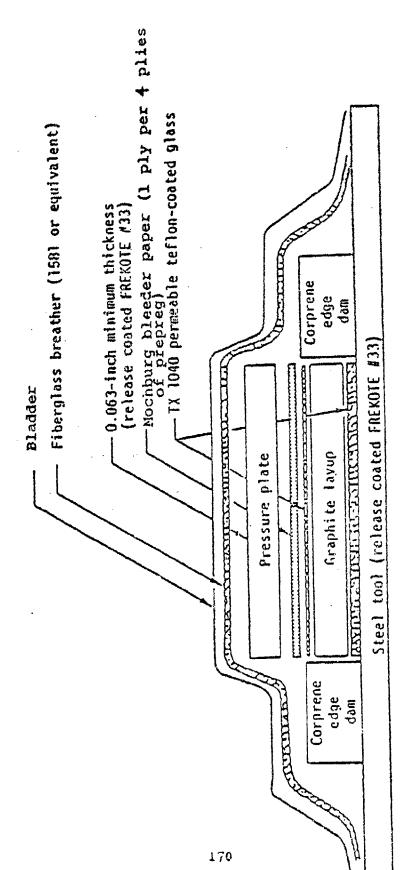


Figure 74. Layup System for HyE 1.076J Laminates.

TABLE 61
PREPREG AND COMPOSITE PHYSICAL PROPERTIES

Composite Ph	ysical Prop	erty Inform	ation	
Material System - HyE 1076J Fiber - T300/15K Matrix - 9			Gr/F	C p
Maximum Rated Temperature -	350°F(177°C)) Pr	eprog by - Fil	erite
Propre	g Physical	Properties		
(Property)	(Stnd.Dev.)	(Range)	(Test Method)	(Ref.)
Volatile Content- 0.44% by w Resin Content- 37.7% by wt. Gel Time - 21.3 minutes No. of Rolls Involved- 1 No. of Batches Involved- 1		37.5-37.8	R-15	
Laminat	e Physical	Properties ^l		····
No. of Panels- 34 Fiber Content- 68.0% by vol. Resin Content- 25.6% by wt.	1.5%	62.3-69.9%	(Test Method) Acid Digestion AFML-TR-67-243	1
Void Content = 0% by vol. Laminate Sp. Gr. = 1.62 Fiber Sp. Gr. = 1.78			D2734 D792 anufacturer.	astm astm
Matrix Sp. Gr 1.28 Thickness per ply-	_		anufacturer.	

The properties reported here represent averages for all panels of this material used throughout the program.

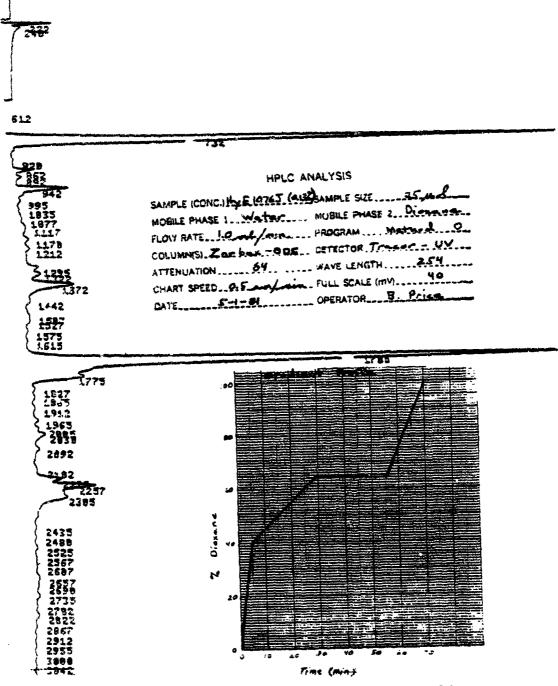


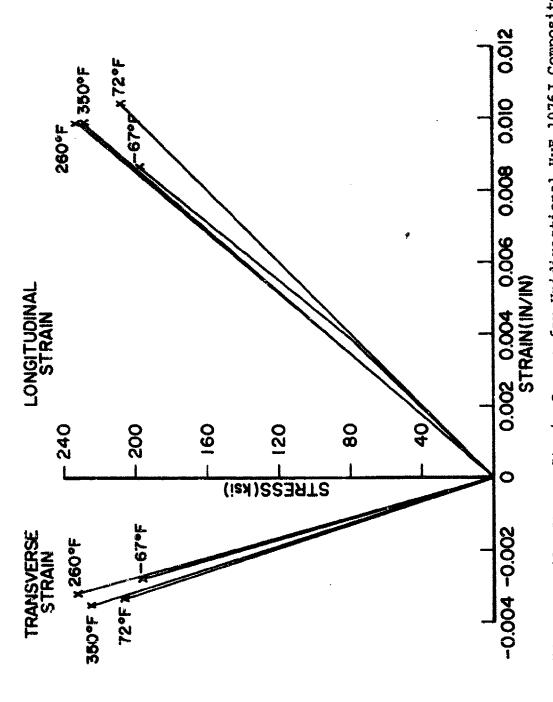
Figure 75. HPLC Analysis of HyE 1076J.

TABLE 62

TENSILE PROPERTIES OF HYE 1076J COMPOSITE LAMINATES

	Composite	Material Properti	es	
Material System - HyE Fiber - T300/15K		Prepreg by -	Piberite	Gr/Ep
Maximum Rated Temperat	Matrix - 976 cure - 350*F(177*C)		Gr 1.60/0; 1.6	
Resin Content - 35.3%/	0: 24.5%/90 by wt.		Thickness-0.0053 is s from which specis	
Fiber Content - 58.6t/ Woid Content - = 0	0; 69.4%/90 by vol.	in this tab		menn water cancer
Thickness of each type	specimen: 0* - 6	ply ; 90*	- 15 ply	
		TENSION: 0°		
	-67°F(-55°C)	72°F(22°C)	260°F(127°C)	350°F(177°C)
Ftu [kmi](MPa)			1	
	(196.8) (1356)	[207.1] (1427)	[232.3] (1601)	(228.4) (1573)
Stnd.Dev.[ksi](MPa) Range [ksi](MPa)	(15.1) (194) (172.5 - 213.5)	{13.4} (92; [190.8 - 219.4]	(15.91 (110) (211.5 - 254.7)	[8-6] (59) [218.7 - 242.2]
	(1189 - 1471)	(1315 - 1512)	(1457 - 1755)	(1507 - 1669)
No. of Specimens	5	S	5	5
F _x [ksi] (MPa)	(196.8) (1356)	[207.1] (1427)	[232.3] (1601)	[228.4] (1573)
Stnd.Dev. (ksi) (MPa)	[15.1] (104)	(13.4) (92)	(15.9) (110)	[8.6] (59)
No. of Specimens	5	5	5	5
Ex [Msi](GPa)	[20.4] (141)	[19.3] (133)	[22-4] (154)	{22.1} (152)
Stnd.Dev. [Mai.] (GPa)	(0.5) (3)	(1.0) (7)	(0.5) (3)	[1.4] (10)
No. of Specimens	5	5	5	5
E μ [μin/in](μακ/αm)	8,600	10,420	9.900	9,930
Stnd.Dev.	450	360	440	530
No. of Specimens	3	5	5	4
υ ^t _{xy}	0.32	0.32	0.31	0.35
Stnd. Dev.	0.02	0.02	0.03	0.03
No. Of Specimens	5	5	5	5
Test Method Reference		Straight-si ASTM D3	ded tension 039	
	7	TENSION: 90°		
F ^{tu} [ksi](MPa)	[4.73] (33)	(5.66) (39)	[3.81] (26)	[3.47] (24)
y Stnd.Dev.[ksi](MPa)	[1.19] (8)	[0.87] (6)	[0.66] (5)	[0.46] (3)
Range	[3.23 - 6.29]	[4.53 - 6.52]	[2.87 - 4.68]	[2.67 - 3.83]
No. of Specimens	(22 - 43) 5	(31 - 45) 5	(20 - 32) 5	(18 - 26) 5
_			De la constante de la constant	
Fy [ksi](MPa)	[4.73] (154)	(5.66) (39)	[3.81] (26)	[3.47] (24)
Stnd.Dev.[ksi](MPa) No. of Specimens	[1.19] (8) 5	(0.97) (6) \$	[0.66] (5) 5	[0.46] (3) 5
E ^t [Msi](GPa)	(1.69] (12)	(1.34) (9)	{1.37} (9)	(2) (30)
Stnd.Dev. [Msi] (GPa)	[0.2] (1)	[0.04] (0.3)	(0.1) (1)	(0.08) (0.6)
No. of Specimens	5	5	5	5
ε ^{tu} [μin/in](μcm/cm)	2,760	3,900	2,640	2,620
Stnd. Dev.	560	570	500	350
No. of Specimens	5	5 	\$	5
v _{yx}	0.0261	0.0221	0.0191	0.0201
Stnd. Dev.				
No. of Specimens				
Test Hethod		04	ded tension	

¹Computed using elastic modulii and longitudinal Poisson's ratio.



Tensile Stress-Strain Curves for Unidirectional HyE 1076J Composite Laminates: 0° Fiber Orientation. Figure 76.

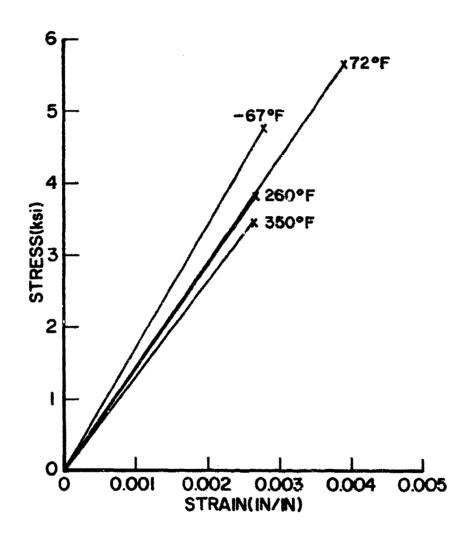
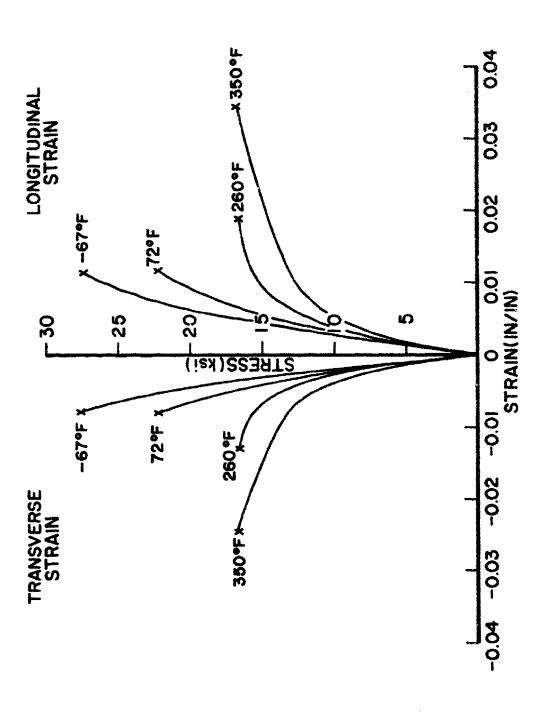


Figure 77. Tensile Stress-Strain Curves for Unidirectional HyE 1076J Composite Laminates: 90° Fiber Orientation.

TABLE 63
TENSILE PROPERTIES OF HYE 1076J
COMPOSITE LAMINATES

	Composite	Material Properti	ies	
Material System - HyE Fiber - T300/15K M Maximum Rated Temperat Resin Content - 25.3% Fiber Content - 67.9% Youd Content - 0.2%	herix - 976 ure - 150°F(177°C) by wt. by vol.	Nominal Ply No. of panel in this tak	Gr 1.62 Thickness - 0.00 Ls from Which spec	rimens were tested
	12	maion: +45.		
	-67°F(-55°C)	77°F (22°C)	260° ! (127° C)	350**(277**C)
ru [ksi] (Ma)	[27.49] (189)	[22-28] (154)	[16.49] (114)	[16.60] (114)
Stnd.Dev. [ksi] (MPa) Range [ksi] (MPa)	[1.92] (13) [26.40 - 30.92] (182 - 213)	[0.28] (2) [22.0 - 22.73] (152 - 257)	(0.79] (5) {15.55 - 17.44} (107 - 120)	(106 - 129)
No. of Specimens	5	5	5	5
Ftpl (kmi](MPa)	[13.61] (94)	[6.42] (44)	[4-36] (30)	[4.21] (29)
Stnd.Dev.(ksi)(MPa) No. of Specimens	(3.62) (25) 5	[1.85] (13) 5	[0.51] (4)	[0.57] (4) S
E (Mai) (Ga)	[3.16] (22)	(3.08) (21)	[3.09] (21)	[2-68] (18)
Stnd.Dev. [Mgi] (GPa) No. of Specimens	[0.14] (1) 5	[0.10] (1) 5	(0.21 (1)	[0-17] (1) 5
ε ^{tu} (μin/in) (μcm/cm)	11,120	11.670	18.880	34,400
Stnd. Dev. No. of Specimens	2,3 8 0 5	1.270	8,820 5	3,390 2 ²
v t xy	0.67	0-67	0.72	0.71
Stnd. Dev. No. of Specimens	0.05 5	9.03 5	0 - 05 5	0.04
Test Hethod Reference		AE	TM D30 39	

 $^{^{1}\}mbox{Strain}$ gages failed on two specimens prior to fracture. $^{2}\mbox{Strain}$ gages failed on three specimens prior to fracture.



Tensile Stress-Strain Curves for Bidirectional HyE 1076J Composite Laminates: +45° Fiber Orientation. Figure 78.

TABLE 64

TENSILE PROPERTIES OF HYE 1076J COMPOSITE LAMINATES

Naturial System - Hys	10763	Propreg by -	Pilmeri te	Gy/Ep
Fiber - T300/15K	Matrix - 976		L.,	42 L MA
Naximum Reted Temperat	ture - 350°F(177°C)	Laminata Sp.		#A :
Resin Content - 25.44				50 inch (0.13 mm) cimens were tested
Fiber Content - 68.4%		in this tab		The sera ceache
Void Content - 0.3t				
Thickness of each type	sheerman to bra		-	
2200	1208: (0. +4545.		3, 90, 01 ₈	
	-67°F(-55°C)	72°8 (22°C)	260°F(127°C)	350°7 (177°C)
F _X (%si](MPa)		[116.8] (805)	(120.1) (827)	(118.1) (814)
Stnd.Dev. [ksi] (PFa)		(7.9) (54)	(5.9) (41)	[6.6] (45)
Range (Xai) (MPa)		[108.9 - 128.1]		(109.3 - 126.3
		(750 - 883)	(801 - 875)	(753 - 870)
No. of Specimens		5	5	5
r ^{tpl} (kail(Ma)		(116 01 (606)	(7.30 1) (407)	(339 11 (034)
x	1	(116.8) (805)	(120.1) (827)	(118.1) (814)
Stad.Dev. (kmi] (NPa)	1	(7.9) (54)	(5.9) (41)	[6.6] (45)
No. of Specimens)	5	5	5
E (Mai) (GP4)	1	(11.2) (77)	[12.2] (84)	[11.9] (82)
-		(0.5] (3)	(9.77 (5)	(0.81 (6)
Stod.Dev.[Hai](GPA) Yo. of Specimens		3	5	5
	1			
cx (pin/in) (pen/em)		10.620	9.780	9.900
Stod.Day.		350	630	430
wneriseq2 to well		5	5	•
t		0.37	0.40	0.36
V _X y		1	1	1
Stud. Dev. No. of Specimens		0.01 5	0.03	0.04
-	1	•	•	
Test Method		AATTA D	3039	
Paramana.	1			
Reference	<u> </u>			
	-45, 0, 0, ~45, +45	, 0, 90, 0) ₉ with	0.1935 inch (0.49	1 cm) hole
TEMESION: (0, +45,	-45, 0, 0, -45, +45	, 0, 90, 0), with (88.5) (610)	0.1935 inch (0.49	1 cm) hole
TENSION: (0, +45, rem (kel) (MPa)	-45, 0, 0, -45, +45	(88.5) (610)	0.1935 inch (0.49	1 cm) hole
TENSION: (0, +45, r th (kmi)(MPs) Stad.Dev.[kmi](MPs)	-45, 0, 0, -45, +45	T T	0.1935 inch (0.49	l cm) hole
TENSION: (0, +45, rem (kel) (MPa)	-45, 0, 0, -45, +45	[88.5] (610) (8.0] (55) [78.6 - 99.1] (542 - 683)	0.1935 inch (G.49	1 cm) hole
TENSION: (0, +45, r th (kmi)(MPs) Stad.Dev.[kmi](MPs)	-45, 0, 0, -45, +45	[88.5] (610) (8.0] (55) [78.6 ~ 99.1]	0.1935 inch (C.49	1 cm) hois
TEMSION: (0, +45, rtm [kmi](NPs) Sind.Dev.[kmi](NPs) Range No. of Specimens	-45, 0, 0, -45, +45	[88.5] (610) (8.0] (55) [78.6 - 99.1] (542 - 683)	0.1935 inch (C.49	1 cm) hois
TEMSION: (0, +45, Fix [ksi](NPs) Y (ksi](NPs) Range No. of Specimens Fipl (ksi](NPs)	-45, 0, 0, -45, +45	[88.5] (610) (8.0] (55) [78.6 - 99.1] (542 - 683)	0.1935 inch (C.49	1 cm) hois
TERSION: (0, +45, rtm (kmi)(NPm) Stand.Dev.[kmi](NPm) Range No. of Specimens Full (kmi)(NPm) Stand.Dev.[kmi](NPm)	-45, O, O, -45, +45	[88.5] (610) (8.0] (55) [78.6 - 99.1] (542 - 683)	0.1935 inch (C.49	1 cm) hois
TEMSION: (0, +45, Fix [ksi](NPs) Y (ksi](NPs) Range No. of Specimens Fipl (ksi](NPs)	-45, 0, 0, -45, +45	[88.5] (610) (8.0] (55) [78.6 - 99.1] (542 - 683)	0.1935 inch (C.49	1 cm) hois
TEMSION: (0, =45, rem [ksi](NPa) Stnd.Dev.[ksi](NPa) Range No. of Specimens rupl [ksi](NPa) Stnd.Dev.[ksi](NPa) No. of Specimens	-45, 0, 0, -45, +45	[86.5] (610) (8.0] (55) [78.6 - 99.1] (542 - 663)	0.1935 inch (C.49	1 ca) hoie
TEMBION: (O, w45, Fin (kmi)(NPm) Sind.Dev.[kmi](NPm) Range No. of Specimens Full (kmi)(NPm) Sind.Dev.[kmi](NPm) No. of Specimens Ety (Mmi)(GPm)	-45, 0, 0, -45, +45	[86.5] (610) (8.0] (55) [78.6 - 99.1] (542 - 663)	0.1935 inch (C.49	1 cm) hoie
TEMSION: (0, =45, rem [ksi](NPa) Stnd.Dev.[ksi](NPa) Range No. of Specimens rupl [ksi](NPa) Stnd.Dev.[ksi](NPa) No. of Specimens	-45, 0, 0, ~45, +45	[86.5] (610) (8.0] (55) [78.6 - 99.1] (542 - 663)	0.1935 inch (C.49	1 ca) hoie
TERSION: (0, *45, Pts (ksi)(NPs) Stnd.Dev.[ksi](NPs) Range No. of Specimens Fupl (ksi)(NPs) Stnd.Dev.[ksi](NPs) No. of Specimens Ety (NSi) (GPs) Stnd.Dev.[Msi] (GPs) No. of Specimens	-45, 0, 0, -45, +45	[86.5] (610) (8.0] (55) [78.6 - 99.1] (542 - 663)	0.1935 inch (C.49	1 ca) hoie
TEMBION: (0, w45, rtm (ksi)(MPs) y Stnd.Dev.[ksi](MPs) Range No. of Specimens rtpl (ksi)(MPs) Stnd.Dev.[ksi](MPs) Stnd.Dev.[ksi](MPs) Stnd.Dev.[ksi](MPs) Stnd.Dev.[ksi](MPs) Stnd.Dev.[ksi](GPs)	-45, 0, 0, -45, +45	[86.5] (610) (8.0] (55) [78.6 - 99.1] (542 - 663)	0.1935 inch (C.49	1 ca) hoie
TEMSION: (0, w45, rtm (kmi)(MPm) Stnd.Dev.[kmi](MPm) Range No. of Specimens Fupl (kmi)(MPm) Stnd.Dev.[kmi](MPm) No. of Specimens Et (Mmi)(GPm) Stnd.Dev.[Mmi](GPm) Stnd.Dev.[Mmi](GPm) Stnd.Dev.[Mmi](GPm) Stnd.Dev.[Mmi](GPm)	-45, 0, 0, -45, +45	[86.5] (610) (8.0] (55) [78.6 - 99.1] (542 - 663)	0.1935 inch (C.49	1 ca) haie
TEMBION: (0, w45, rtm (ksi)(MPs) y Stmd.Dev.[ksi](MPs) Range No. of Specimens Fy (ksi)(MPs) Stmd.Dev.[ksi](MPs) No. of Specimens Ety (Msi)(GPs) Stmd.Dev.[Msi](GPs) Stmd.Dev.[Msi](GPs) Cy (Msi)(GPs)	-45, 0, 0, -45, +45	[86.5] (610) (8.0] (55) [78.6 - 99.1] (542 - 663)	0.1935 inch (C.49	1 ca) hoie
TEMBIOM: (0, +45, rtm (kmi)(NPm) y (kmi)(NPm) Stnd.Dev.(kmi)(NPm) Range No. of Specimens Ful (kmi)(NPm) Stnd.Dev.(kmi)(NPm) No. of Specimens Et (Mmi)(GPm) Stnd.Dev.(Mmi)(GPm) Stnd.Dev.(Mmi)(GPm) Stnd.Dev.(Mmi)(GPm) Stnd.Dev.(Mmi)(GPm) Stnd.Dev.(Mmi)(GPm) Stnd.Dev.(Mmi)(GPm) Stnd.Dev.(Mmi)(GPm) Stnd.Dev.(Mmi)(GPm)	-45, 0, 0, -45, +45	[86.5] (610) (8.0] (55) [78.6 - 99.1] (542 - 663)	0.1935 inch (C.49	1 ca) hoie
TEMBION: (0, +45, Ptm (kmi)(NPm) Stmd.Dev.[kmi](NPm) Stmd.Dev.[kmi](NPm) Stmd.Dev.[kmi](NPm) Mo. of Specimens Et (Mmi) (GPm) No. of Specimens Ctu (Mmi) (GPm) No. of Specimens Ctu (Mmi)(Nmi)(Nmi) Stmd.Dev. (Mmi) Stmd.Dev. (Mmi)	-45, 0, 0, -45, +45	[86.5] (610) (8.0] (55) [78.6 - 99.1] (542 - 663)	0.1935 inch (C.49	1 ca) hais
TEMBION: (O, w45, Fix (ksi)(NPs) Sind.Dev.[ksi](NPs) Sind.Dev.[ksi](NPs) Fy (ksi)(NPs) Stnd.Dev.[ksi](NPs) No. of Specimens Ety (Nsi)(GPs) Stnd.Dev.[Msi](GPs) Stnd.Dev.[Msi](GPs) Stnd.Dev.[Msi](GPs) Stnd.Dev.	-45, 0, 0, -45, +45	[86.5] (610) (8.0] (55) [78.6 - 99.1] (542 - 663)	0.1935 inch (C.49	1 ca) hoie
TEMBION: (0, +45, Ptm (kmi)(NPm) Stmd.Dev.[kmi](NPm) Stmd.Dev.[kmi](NPm) Stmd.Dev.[kmi](NPm) Mo. of Specimens Et (Mmi) (GPm) No. of Specimens Ctu (Mmi) (GPm) No. of Specimens Ctu (Mmi)(Nmi)(Nmi) Stmd.Dev. (Mmi) Stmd.Dev. (Mmi)	-45, 0, 0, -45, +45	[88.5] (610) (8.0] (55) [78.6 - 99.1] (542 - 683)	0.1935 inch (C.49	1 ca) haie

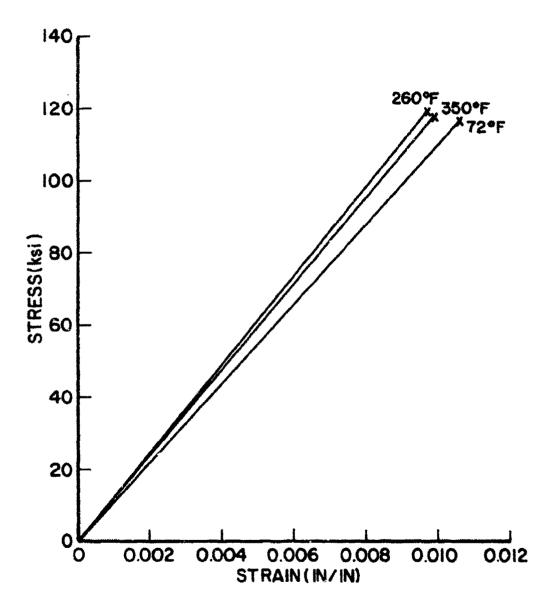


Figure 79. Tensile Stress-Strain Curves for Multidirectional HyE 1076J Composite Laminates: (0,45-45,0,0,-45,45,0,90,0)_S Fiber Orientation.

TABLE 65

COMPRESSIVE PROPERTIES OF HyE 1076J COMPOSITE LAMINATES

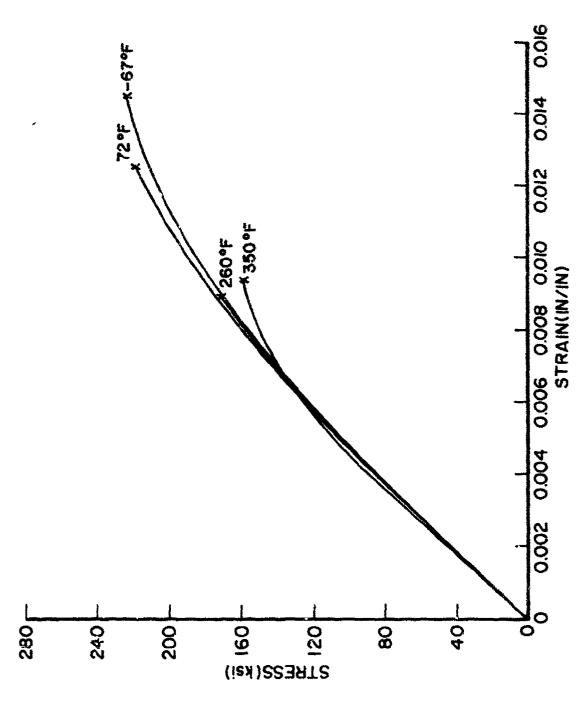
	Composite	Material Propertie	es	
Material System - MyE : Fiber -T300/15K Matr: Maximum Rated Temperat: Resin Content - 24.3% : Fiber Content - 69.5% : Void Content - 20% by Thickness of each type	ix + 976 ire - 350°F(177°C) by wt. by vol. y vol.	No. of panel: in this tab	Gr1.63 Thickness -0.0050 s from which spec: le - 2	
	COR	PRESSION: 0*		
	-67°F(-55°C)	72°F (22°C)	260°F(127°C)	350°F(177°C)
F _X ^{CU} [ksi] (MPa) Stnd.Dev.[ksi] (MPa)	[223.4] (1539) [21.8] (150)	(218.2]. (1503) (34.7) (239)	[170.9] (1178) [37.1] (256)	[158.5] (1092) [29.3] (202)
Range {ksi} (MPa) No. of Specimens	(1348 - 1747) 5	(161.9 - 248.1) (1115 - 1709) 5	[111.1 - 205.1] (765 - 1413) 5	[124.2 - 185.6] (856 - 1279) 5
rcpl [ksi](MPa)	[63.8] (440)	[116.7] (804)	[62.9] (433)	[86.4] (595)
Stnd.Dev.[ksi](MPa) No. of Specimens	[20.0] (138) 5	(88.9) (613) 5	[30.0] (207) 5	(34.6) (238) 5
E ^C [Msi](GPa) Stnd.Dev.[Msi](GPa) No. of Specimens	[21.9] (151) [4.4] (30)	[21.8] (150) [2.9] (20)	(21.4) (147) (5.7) (39)	(22.9) (158) (3.0) (21) 5
ε ^{cu} [μία/in] (μεπ/cm)	14,500+1,2	12,500+1,3	8,900+1,3	9,400
Stnd. Dev. No. of Specimens	4,600 5	4,000 5	2,700	3,700 5
Test Hethod Reference		ASTM	D3410	
	001	PRESSION: 90*		
rou [ksi] (MPa)	[35.1] (242)	[30.8] (212)	(22.6) (156)	[19.1] (132)
Stnd.Dev.[ksi](MPa) Range No. of Specimens	[6.6] (45) [26.7-44.9] (184 - 309)	[1.3] (9) [26.7~31.9] (184 - 220)	(2.4) (17) (19.4-25.7) (134 - 177)	(2.2) (15) (17.3-22.8) (119 - 157)
	-			
Y [ksi](MPa) Stnd.Dev.[ksi](MPa) No. of Specimens	[9.9] (68) (3.9) (27) 5	[11.0] (76) [1.9] (13) 5	[4.5] (31) [1.0] (7) 5	[7.1] (49) [3.7] (25) 5
Ey [MSi] (GPa)	[1.84] (13)	[1.46] (10)	(1.34) (13)	[1.64] (11)
Stnd.Dev. [Mai] (GPa) No. of Specimens	[0.31] (2)	[0.19] (1) 5	(0.68) (4)	[0.32] (2) 5
ε ^{CU} [μin/in] (μcm/cm) Stnd. Dev. No. of Specimens	22,100+ ^I , h 6,400 5	32,300+ ¹ 3 ⁴ 14,400 5	17,600	14.200+ 1,2 6,700
Test Method Reference	Section 2015	Ast	M D3410	1

Ultimate strain value represents maximum observed strain rather than ultimate values.

Three of five specimens exhibited evidence of buckling.

Two of five specimens exhibited evidence of buckling.

One of five specimens exhibited evidence of buckling.



Compressive Stress-Strain Curves for Unidirectional HyE 1076J Composite Laminates: 0° Fiber Orientation. Figure 80.

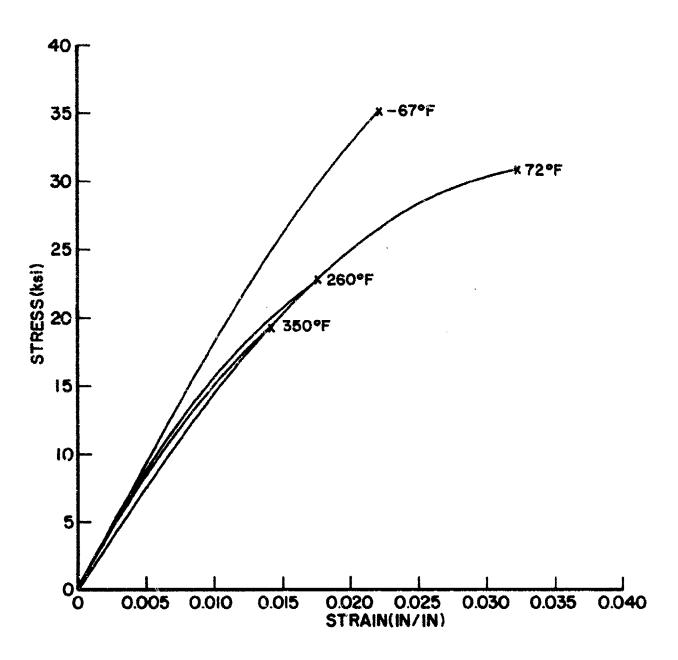


Figure 31. Compressive Stress-Strain Curves for Unidirectional HyE 1076J Composite Laminates: 90° Fiber Orientation.

TABLE 66
FLEXURAL PROPERTIES OF HYE 1076J
COMPOSITE LAMINATES

Material System - Sys Fiber - T300/15%	1076J Macrix - 976	Prepreg by -		Gz/Ep
Maximum Rated Temperat Resin Content - 25.1 Fiber Content - 58.0	thre - 350°F(177°C) 1 by wt. 1 by vol. 2 by vol.	No. of panel: in this tab	Thickness - 0.3056 s from which specials - 2	
	1	TEXUES: 0°		
	-67°¥(-55°C)	72°\$ (22°C)	260°5 (127°C)	350°F(177°C)
riu (ksi) (ksi)	[261.9] (1804)	[190.1] (1310) ¹	{156.8}(1080) ²	(135.9) (1281)
Stnd.pev. (ksi) (MPa) Range (ksi) (MPa)	[13.9] (96) [239.3 - 276.3] (1649 - 1904)	[3.6] (25) [186.3 - 195.8] (1284 - 1349)	[11.5] (79) [148.1 - 176.2] (1020 1214)	(8.2) (56) [176.0 - 197.4] (1226 ~ 1360)
No. of Specimens	5	5	5	4
ef (Mei)(GPa)	[18.6] (3.28)	(14.9) (103)	[13.1] (90)	(18-3) (126)
Stnd.Dev.[Msi](@a) No. of Specimens	[0.7] (5) 5	{0.7} (5) S	(0.8) (6) 5	(1-1) (8)
Test Method Reference	3 pt. flex.	4 pt. flex. ed Composite Design	4 pt. flax. 1 Guide: Jam. 1971	3 pt. flex.
		LEXURE: SO*		
r ^{gu} [kai] (MPa)	(10-31) (71)	(8.79) (60)	[7.42] (51)	[7.03] (48)
: Stmi.Dev.[ksi](MPa) Range [ksi](MPa)	(1.52) (10) (8.34 - 11.78) (57 - 81)	[1.19] (8) [7.38 - 10.66] [51 - 73]	[1.37] (9) [5.85 - 9.06] (40 - 62)	[1.16] (8) [5.86 - 8.66] (40 - 60)
No. of Specimens	5	5	5	5
E _v [Mai](GPa)	[1.84] (13)	[1.71] (81)	[1.62] (11)	(1.45) (10)
Stnd.Dev.[Mei](GPa) Mo. of Specimens	[0.21] (1) S	(0.16] (1) S	[0.10] (1)	[0.17] (I) 5
Test Hathod Reference			flexure ite Design Guide:	7am 1077 b

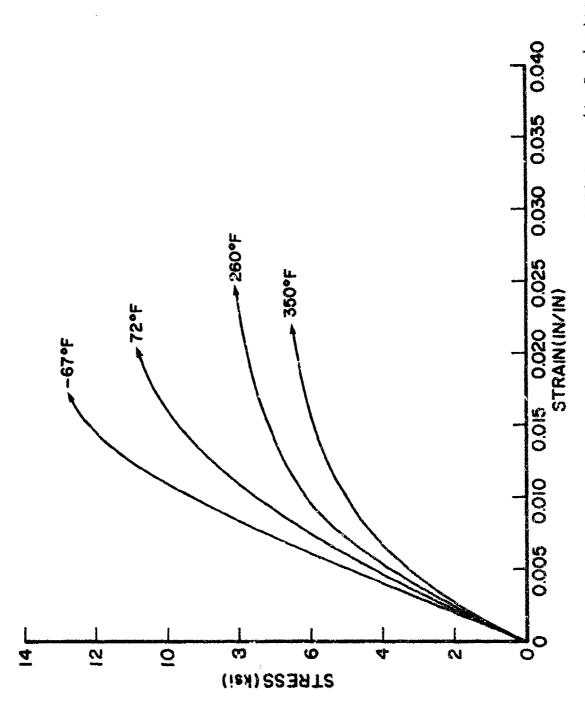
lall failures in tension on lower surface.

²All specimens exhibit compressive failure on upper surface.

All specimens exhibit compressive failure on upper surface. One specimen tested in 4 pt. flaxure failed in shear at a load corresponding to a flaxural stress of 145.7 ks. (1004 MPs). This procedure corresponds to AETM D790 except for loading speed and, in the case of the 4 pt. test, the position of the upper loading points.

TABLE 67
SHEAR PROPERTIES OF HYE 1076J
COMPOSITE LAMINATES

Material System - Hy Fiber - T300/15K Maximum Rated Tempera Resin Content - 24.7% Fiber Content - 68.8% Void Content - *0.1% Thickness of each typ	Matrix - 976 ture - 350°F(177°C) by wt. by wol. by wol.	No. of pane in this ta	Thickness - 0.0055 Is from which specials - 11	
	23	OPLANE SHEAR		
	-67°P(-55°C)	72°¥ (22°C)	260°F(127°C)	350 ? (177°C)
FSU [ksi] (MPa)	(13.75) (95)	[11.14] (77)	(8.25] (57)	[8.30] (57)
'xy [mai] (mra) Stnd.Dev.[ksi] (Mra)	[0.96] (7)	[0.14] (1)	[0.39] (3)	[0.65] (4)
Range [ksi](MPa)	[13.20 - 15.46]	(11.09-11.36)	[7.78 - 8.72]	[7.67 - 9.36]
No. of Specimens	(91 - 107)	(76-78) 5	(54 - 60)	(53 -64)
us. or spacimus				
Gs [Hai] (GPa)	[1.00] (7)	[0.92] (6)	[0.89] (6)	[0.77] (5)
Stnd.Dev.[Msi](GPa) No. of Specimens	(0.07) (1) S	(0.05) (1) 5	[0.05] (1) 5	[0.06] (1) 5
Test Method Reference	J. Com	+45° straight-sid p. Mtls. (Vol. 6,	Med tammion p. 252 & Vol. 7, p	. 124)
	Des	enlandhar shear		
risu (ksil ()@a)	[16.62] (115)	[12.87] (89)	[9.36] (64)	(8.60) (59)
Stnd. Dev. [ksi] (MPa)	[2.12] (15)	[2.36] (1.6)	[0.95] (6)	[0.69] (5)
Range	[14.24 - 19.64] (98 - 135)	[9 42 - 17.11] (65 - 118)	[8.59 - 10.79] (59 - 74)	[7.72 - 9.56] (53 - 66)
No. of Specimens	5	10	5	5
Test Method		ASTM I	2344	
Test Method Reference		ASTM I	2344	



Inplane Shear Stress-Strain Curves for HyE 1076 Composite Laminates. 82. Figure

TABLE 68

Manager Street Contract

TENSILE, COMPRESSIVE, AND SHEAR PROPERTIES OF HYE 1976J COMPOSITE LAMINATES AFTER HUMIDITY AGING

	***************************************			Composite Material Properties	dal Properties		***************************************		
Material System - HVE	HVE 10763		Pilherate	Gr/Eo		8	PRESSION: 50"		
	AC0 : Y	repres of				72*F(22°C)	260*F (127*C) D2*F (22*C)	i	260°F(127°C)
Maximum Rated Temperature - 350°F	ure - 350°F	Mominel Ply	Thickness -0	.0050 in. (0.13mm)	Moninal Ply Thickness -0.0050 in.(0.13mm/Exposure Time(hrs)	161	161	1242	1242
Resin Content - 24.4% by wt. (177°C)	by wt. (177°C)	No. of pene	Mo. of penels from which apecimens	rpecimens	Ht. Gain(h of orig.	0.73	97.0	1.091	1.051
Void Content - 01 by vol.	. woz.	Aging Condi	Were tested in this texts - 0 Ading Conditions - 160°F(71°C)	were tested in this value - o Aging Conditions - 160°F(71°C) £100% R.H.	Stnd. Dev. (%)	0.05	0.05	0.02	0.05
Thickness of each type specimen:		engion - 15 p	Tension - 15 ply; Cospr 20 ply;	20 ply:	No. of Specimens	ın.	u)	so.	s.
	q	Sheer - 15 ply			12011 [7 2081 1941 1941 DOWN	133.737.156.1	(50 01/113)	(25.9 (176)	(19.5) (134)
	TEMBION	08; 90 _*			6	76 63 (463	ferri forcer	(5,8) (19)	(2.6)(18)
***************************************							(6/1/17-2)	121.8-20.3	117.9-23.41
Paroceura Class Days	72.7 (22.5)	(3.2(T)1.09d	72.2(22.5)	260 7 (127 °C)	Karuge	[11.3-28.3]	[29.2-24.3]	(150 - 202)	(123 - 161)
Wt. Gain(1 of criq.	0.77	0.76	1.17	133	No. of Specimens	(1564 D	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	មា	
Cory st.	•			3	•	,			
No. of Specimens		Š 10	3 4	วี พา	PCPI [kal] (wpa)	[kal] (WPa.) [3.8] (26)	(4.0) (38)	(10.4)(72)	[6.7] (46)
		•		1	Stnd. Dav. (ksi) (SPa) [1.6] (11)	(11.6) (11.)	[1.4] (10)	(2.71(19)	(2.1)(14)
Ptu [ksi] (HPa) [4.80] (33)	(4.80) (33)	[2,90](20)	[4.03] (28)	(11.49)(10)	No. of Specimens	•	50	ហ	'n
Dav.	[0.73](5)	[0.47] (3)	(0.18)(1)	[0.42](3)	EC (Mail (GDa) (2,22) (15)	(2, 22) (15)	11.911(13)	[1.63](11)	(1.64) (11)
Range (ksi] (MPa)	(ksi) (#Pa) [4.14-5.98]	[2.47-3.63]	[3.80-4.26]	[1.03-1.99]	A.		/et [* / . v]		
	(14 - 52)	(17 - 25)	(26 - 29)	(8 - 18)	Stnd. Dev. [Mail (GPa) [0.16] (1)	(0.16) (3)	10.39}(3)	10.21; (1)	(6) (05:01
so. or specimens	rı.	^_	n	'n	No. of Specimens	•	'n	n	n
F'FL [kaij (sPa) [3.49] (24	(3.49] (24)	(1.31) (9)	(3.83)(26)	(1.05)(7)	ecu [pin/in] (pow/om)	21,450	18,8602	31,7003	22,220
Stnd. 5.v. (hel) (hFa) [1.63] (11)	(11.63) (11)	[0.64] (4)	(6.59) (4)	(0.24)(2)	Stnd. Dev.	7,090	10,850	068'6	6,250
No. of Specimens	ผา	10	ſŲ.	'n	No. of Specimens	*	*	e	ır.
E, [Med.] (GP.) [1.41] (10)	(1.41)(10)	[11.20](8)	(3.41)(10)	(1)(63)(7)	Test : Method	-	ASTW	ASTM D3410	
Stnd. Lwr. [Mail (Gra) [0.09](L)	(1) (60.0)	(0.09)	(1) (01.0)	(0.16)(1)	Reference				
No. of Speciment	w	ית	vi	50		INTER	INTERLACINAR SYEAR		
etu (pin/ka) (nom/rm)	3,500	2,700	2,800	1.480	Exposure Time (hrs)	168	188	1675	1675
Send. Day.	240	373	200	300	dry wt.)		0.64	1.11	1.21
No. of Specimens	u²i	٠,	ιs	lin.	Stnd. Dev. (4)	6.17	0.28	0.16	0.05
					No. of Specimens	01	ın	ន	\$
Reference		Straight-Bide ASTR 03039	Straight-Bined tension ASTM 03039		risa (ksi) (10a)	[111.88] (81.9)	[8.44] (58.2)	[11.98] (82.5)	(11.98) (62.5) (6.84) (47.1)
					Stnd. Dav. (kel) (MPa)	(1.68)(11.6)	[11.57](10.8)	(1.55)(30.7)	[0.54] (3.72)
						(66.3-104.5)	(44.4-68.3)	(64.9-97.1)	
					No. of Specimens	01	'n	91	ss.
					Test Method Reference		ASTR	, Astr D2344	-

Represents 100% saturation at aging conditions.

One of flow specimens exhibited evidence of buckling.

Two of flow specimens exhibited evidence of buckling.

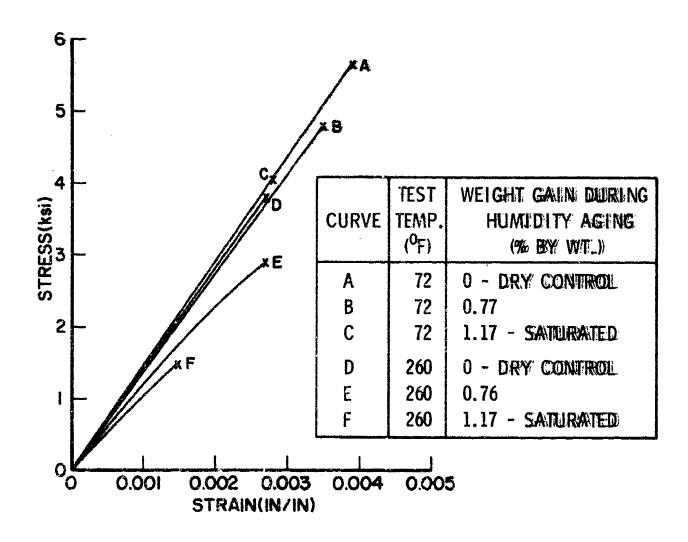
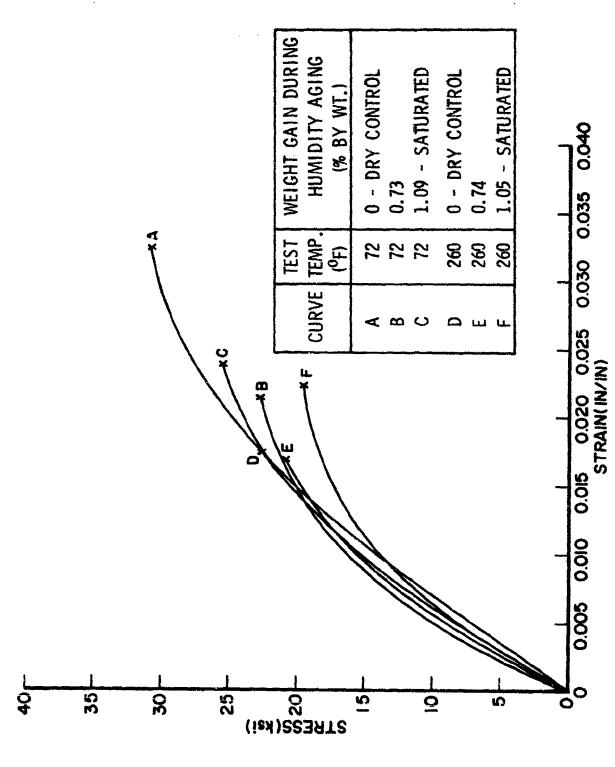


Figure 83. Tensile Stress-Strain Curves for Unidirectional HyE 1076J Composite Laminates After Humidity Aging at 160°F (71°C) and 100% R.H.: 90° Fiber Orientation.



Compressive Stress-Strain Curves for Unidirectional HyE 1076J Composite Laminates After Humidity Aging at 160°F (71°C) and 100% R.H.: 90° Fiber Orientation. 84 Figure

TABLE 69

CREEP PROPERTIES OF HyE 1076J COMPOSITE LAMINATES

Composite Material Properties

Fiber - T30		Propreg by - Fiberita	Gr/Ep				
Resin Conte Piber Conse Void Conten	- Straight-sided tension	Co) Laminate Sp. Gr. ~ 1.62 Nominal Ply Thickness - 0.0053 inch(0.11 me No. of panels from which specimens were tenesed in this table - 15 Thickness of each type specimen: 0/45/90 - 20 ply 445 - 8 ply					
CHEFF							
Temperature	Piber Offentation	(0,+45,-45,0,0,-45,+45,0,90,0)g	±45°				
72°Y (22°C)	Stress Level (ksi](MPa) Creep Strain, 500 hr(%) No. of Specimens Residual Strength(ksi)(MPa) No. of Specimens	[93.5] (644) 0.0239 1 ¹ (130.9] (902)	(20.05) (138) 3 0				
	Stress Level (kai) (MPa) Creep Strain, 500 hr(%) No. of Specimens Besidual Strength(kai) (MPa) No. of Specimens	[81.8] (564) 0.0121 3 [115.6] (796) 3	(17-83) (123) 0.3005 3 [24-40] (168) 3				
	Streem Level [kmi] (MPa) Creem Strein, 500 kr(%) No. of Specimens Secided Streemth(kmi] (MPa) No. of Specimens	(70.1) (483) 0.0254 1 (104.3) (719)	(15.60) (107) 0.2074 3 [23.35] (161)				
360°F (127°C)	Stress Level (ksi)(MPa) Creep Strain, 500 hr(%) No. of Specimens Residual Strength(ksi)(MPa) No. of Specimens	(96.1] (662) 0.0003 1 (134.3] (925)	(13.19] (91) —				
	Stress Level [ksi](197a) Creep Strain, 500 hr(%) No. of Specimens Residual Strength(ksi](197a) No. of Specimens	[84.1] (579) 0.0002 3 [111.4] (768) 3	(11.55) (80) 0.3870 2 (22.72) (157) 2				
	Streen Level [kmi](MPa) Creep Strain, 500 hr(%) No. of Specimens Residual Strength(kmi](MPa) No. of Specimens	[72.0] (496) 0.0109 3 [111.6] (769)	(9.90) (68) 0.4191 3 (20.88) (144) 3				
350°F (177°C)	Stress Level [Rei](MPa) Creep Strain, 500 hr(%) No. of Specimens Residual Strength(Rei](MPa) No. of Specimens	[94.5] (651) 0.0183 2 (119.2] (821) -2~	(13.28) (91) 				
	Strees Lovel (kmi)(HPa) Creep Strain, 500 hr(%) No. of Specimens Residual Strength(kmi](HPa) No. of Specimens	[82.7] (570) 0.0607 3 (112.0) (772)	(11.62) (80) 0.8734 1 (26.93) (144) 3				
	Streen Level (kmi) (HPA) Creep Strain, SOU hr(%) No. of Specimens Residual Strength(kmi) (HPA) No. of Specimens	[70.9] (489) 0.0754 3 [115.8] (798)	[9.96] (69) 3 (19-52] (134)				

ことをこればのでは、これには、これで、こので、このできなっているととは、またのできないのでは、これでは、これできないできないできない。

Three specimens fulled on loading or during test.

Strain exceeded limits of gage capabilities prior to end of test.

Two specimens broke on loading.

One specimens failed during test.

Two specimens failed on two specimens during test.

Two specimens failed during test.

Tone specimens failed on loading.

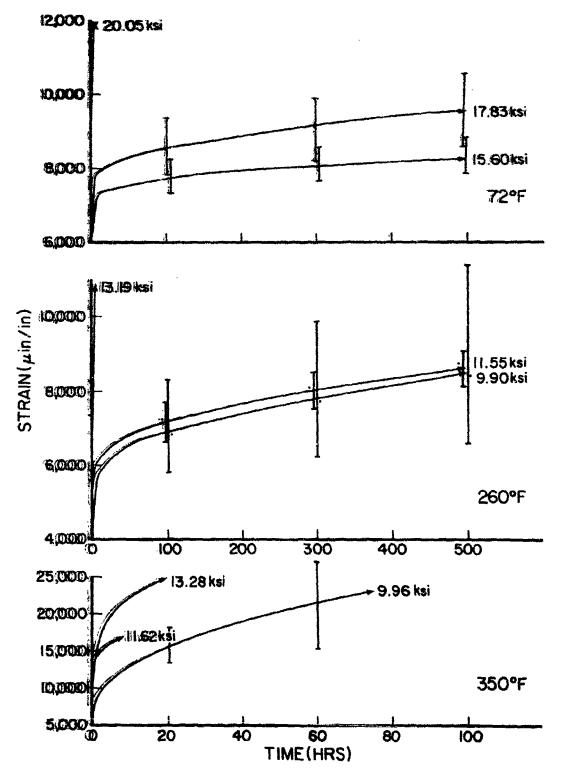


Figure 85. Tensile Creep Behavior of Bidirectional HyE 1076J Composite Laminates: +45° Fiber Orientation.

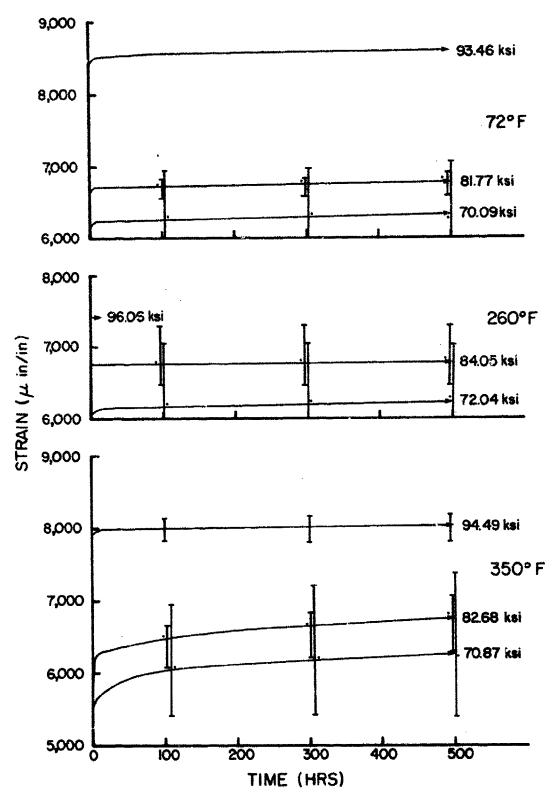


Figure 86. Tensile Creep Behavior of HyE 1076J Composite Laminates: (0,+45,-45,0,0,-45,+45,0,90,0)_s Fiber Orientation.

TABLE 70

STRESS-RUPTURE BEHAVIOR OF HYE 1076J COMPOSITE LAMINATES

Composité Material Properties

<u></u>						
Fiber - T300 Maximum Temm Resin Content Fiber Content Void Content Test Method	# HyE 1076J /15K ###################################	Gr/Epoxy Prepred by - Fiberite Laminate Sp. Gr 1.62 Nominal Ply Thickness - 0.0053 inch (0.13 mm) No. of panels from which specimens were tested in this table - 16 Thickness of each type specimen: (0/+45/90) - 20 ply +45 - 8 ply				
STRESS RUPTURE						
Temperature	Fiber Orientation	(0,+45,-45,0,0,-45,+45,0,90,0);	<u>+</u> 45°			
72°F (22°C)	Stress Level[ksi](MPa) Time to Failure(hrs) No. of Specimens Residual Strength(ksi](MPa) No. of Specimens	(93.5] (644) 167+ ¹ 3 (130.9] (902) 1	{17.83} (123) 500+ 3 [24.40] (168)			
:	Stress Level[ksi](MPa) Time to Pailure(hrs) No. of Specimens Residual Strangth(ksi](MPa) No. of Specimens	(81.8] (564) 500+ 3 [135.6] (796) 3	[15.60] (107) 500+ 3 [23.35] (161) 3			
260°F(127°C)	Stress Level[ksi](MPa) Time to Failure(hrs) No. of Specimens Residual Strength(ksi](MPa) No. of Specimens	[96.1] (662) 256+ ² 3 [134.3] (925)	[13.19] (91) 500+ 3 [22.45] (155) 3			
	Stress Level[ksi] (MPa) Time to Failure(hrs) No. of Specimens Residual Strength(ksi] (MPa) No. of Specimens	[84.1] (579) 500+ 1 (111.4] (768)	[9.90] (68) 500+ 3 [20.88] (144) 3			
350°F (177°C)	Stress Level[ksi](MPa) Time to Failure(hrs) No. of Specimens Residual Strength[ksi](MPa) No. of Specimens	[94.5] (651) 334+ ² 3 [119.2] (821) 2	[13.28] (91) 500+ 3 [21.64] (149) 3			
	Stress Level[ksi] (MPa) Time to Failure(hrs) No. of Specimens Residual Strength(ksi] (MPa) No. of Specimens	(82.7] (570). 500+ 3 [112.0] (772)	[11.62] (80) 500+ 3 [20.93] (144) 3			

Two specimens broke on loading.

Two specimens broke during test.

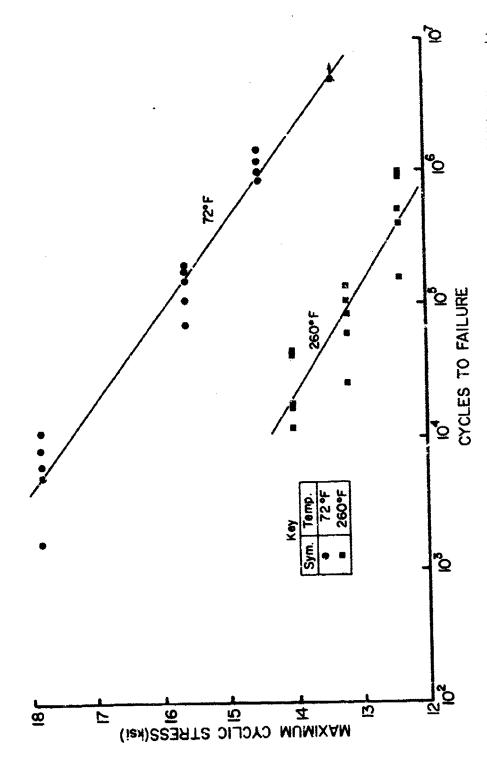
One specimen broke on loading.

TABLE 71

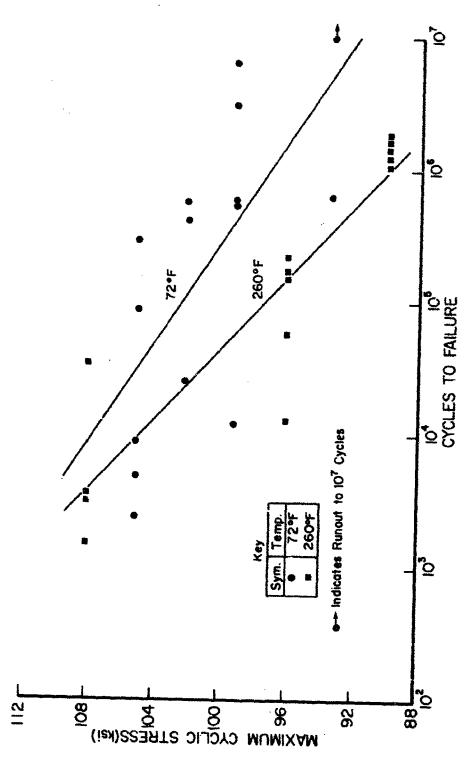
TENSILE-TENSILE PATIGUE PROPERTIES OF HyE 1076J COMPOSITE LAMINATES

Composite Naterial Properties							
Fiber - T300 Maximum Tempo Resin Content Fiber Content Void Content	reture Rating - 350°F(177°C) t - 25.2% by wt. t - 68.1% by vol. - 0.2% by vol. - Straight-sided tension	Prepring by - Piberita Gr/Ep Laminate Sp. Gr 1.62 Hominal Ply Thickness - 0.0052 inch (0.13 mm) Ho. of panels from which specimens were tested in this table - 20 Thickness of each type specimen: +45 - 8 ply 0/+45/90 - 20 ply					
	A POSTA	FATIGUE. 3-0.1					
Temperature	Piber Orientation	<u>+</u> 45*	0/ <u>+</u> 45/90 ¹	0/445/9017			
72°F (22°C)	Nax. Stress[ksi] (MPa) Lifatime (cycles) No. of Specimens Residual Strength(ksi] (NPa) No. of Specimens Nax. Stress[ksi] (NPa) Lifetime (cycles) No. of Specimens Residual Strength(ksi] (NPa) No. of Specimens Nax. Stress[ksi] (NPa) Lifatime (cycles) No. of Specimens Residual Strength[ksi] (NPa) Lifatime (cycles) No. of Specimens Residual Strength[ksi] (NPa) No. of Specimens	[17.82] (123) 5,701 5 0 [15.60] (107) 136,004 5 0 [14.48] (100) 1,120,500 4 0	[105.1] (724) 19,153 5 0 [102.2] (704) 182,507 3 0 [99.3] (684) 598,592 5	[97.4] (671) 735 2 0 [92.9] (640) 6421 4 0 [88.5] (610) 94,313 5 [119.3] (815)			
260 °F(127°C)	Max. Stress[ksi] (MPa) Lifetimm (cycles) No. of Specimens Residual Strength (ksi] (NPa) No. of Specimens Max. Stress[ksi] (NPa) Lifetime (cycles) No. of Specimens Residual Strength (ksi) (NPa) No. of Specimens Max. Stress[ksi] (NPa) Lifetime (cycles) No. of Specimens Residual Strength (ksi) (NPa) No. of Specimens Residual Strength (ksi) (NPa) No. of Specimens	0 [12.37] (85) 488,973 5	[108.1] (745) 4,850 4 0 [96.1] (662) 84,188 5 				

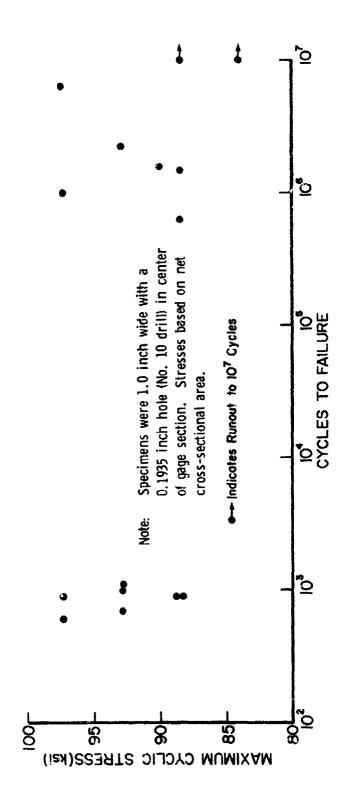
 $^{^1\}mathrm{Stacking}$ sequence (0,+45,-45,0,0,-45,+45,0,90,0)g. $^2\mathrm{These}$ specimens had a 0.1935 inch (0.491 cm) hole in the center of the test section. Stresses calculated using net cross-sectional area. $^3\mathrm{Fatigus}$ lifetimes are log-mean values.



Tensile-Tensile Fatigue Behavior of Bidirectional HyB 1076J Composite Laminates: $+45^{\circ}$ Fiber Orientation, R = 0.10, 10 Hz. 87. Figure



Tensile-Tensile Fatigue Behavior of Multidirectional HyE 1076J Composite Laminates: (0,45,-45,0,0,-45,45,0,90,0)g Fiber Orientation, R = 0.10, . 88 Figure



Tensile-Tensile Fatigue Behavior of Multidirectional HyE 1676J Composite Laminates: (0,45,-45,0,0,-45,45,0,00,0) Fiber Orientation, R = 0.10, Figure 89.

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TABLE 72

THERMOPHYSICAL PROPERTIES OF HYE 1076J COMPOSITE LAMINATES

	Compos	ite Material	Properties		<u> </u>
Material System - HyE 107 Fiber - T300/15K Matri: Maximum Temperature Ratin Resin Content - 25.6% by Fiber Content - 67.7% by Void Content - 60% by Thickness of each type spe					
	TREPHOP	HYSICAL PROPE	RTTES: 0*		
	-67°F(-55°C)	72*F(22*C)	260 °F(127°C)	350°F(177°C)	Test Mathod
Thermal Eupanuion 1 og [uin/in-*F] (ucm/cm-*C)	(0.08) (0.15)	[~0.30](~0.54)	[-0.24](-0.4 4	{-0:18}(-0:32)	THA ²
α _y (μέτ/in-*F) (μαπ/απ-*C)	(12.5) (22.5)	[13.6](24.4)	[17.4] (31.4)	[19.2](34.6)	
No. of Specimens per direction	3	3	3	3	
Specific Hoat Cp[btu/lb*F](J/kg-*C)	DSC3				
No. of Specimens	3	3	3	3	
Thermal Conductivity 1 k ₂ [btu-ft/ft ² -hr-°F] (W/m-°C) No. of Specimens	[0.37] (0.64) 3	[0.42] (0.72) 3	(0-481 (0-84) 3	{0.51} (0.89) 3	Comparative
Glass Transition Temp. Dry ["F]("C) Wet ("F)("C)	DMA ⁴				
	TENCPI	YSICAL PROPER	TIES: ±45*		
Thermal Expansion 1 α_{χ} [min/in-*F] (mcm/cm-*C)	[1.7] (3.1)	[1 4] (7.6)	[1.4] (2.5)	(1.5] (2.7)	TMA ²
No. of Specimens per direction	3	3	3	3	
Thermal Conductivity k _z [btu-ft/ft ² -hr~*F] (W/m-*C) No. of Specimons	[0.28] (0.48)	[0.39] (0.67) 3	[0.53] (0.92) 3	(0.61) (1.05) 3	Comparative

NOTES:1. On the unidirectionally reinforced specimens, the x-direction is along the fiber axis, the y-direction is across the fiber axis, and the x-direction is through the thickness (identical to the y-direction). On ±45° bidirectionally reinforced specimens, the x and y directions are identical and oriented at 45° to either fiber direction, while the x-direction is through the thickness.

2. Thermo-Mechanical Analysis.

The second secon

- 3. Differential Scanning Calbrimetry.
- 4. Dynamic Machanical Analysis.

TABLE 73

COMPARISON OF 934 AND 976 RESIN PROPERTIES 1

RESIN	934	976
VISCOSITY, cps	6,000-12,000	6,000-12,000
*At 75 ± 0.5°C *Brookfield Model HBT Viscometer *Fiberite FTM-V-9 Test Method		
GEL TIME, MINUTES	8-16	15-30
*At 170 + 10°C (934), 177 + 1°C (976) *Fisher-Johns Melting Point Apparatus *Fiberite FTM-G-3 Test Method	; :	
SPECIFIC GRAVITY OF CURED RESIN	1.30	1.28
*At 23 ± 2°C *Analytical Balance *ASTM-D-792 Test Method		
Z WEIGHT LOSS	.450	.255
*RT to 200°C *T.G.A. *Heat-Up rate 5°C/Min		
CAST RESIN PROPERTIES		
*Tensile Strength, ksi *Tensile Modulus, msi *Tensile Elongation, %	8,000-10,000 .35 3	8,000-10,000 .35 5

*Mean Glass Transition Temperature, *C 214

250

¹All data in this table provided by FIBERITE.

TABLE 74
COMPARISON OF DAY/WET MECHANICAL PROPERTIES¹

	hy-E 1034C	hy-E 1076C
CURED LAMINATE		
Resin Content, 7	24.0	25.7
Fiber Volume, %	70.0	68.6
Void Content, Z	0	0
Specific Gravity	1.62	1.63
Nominal Cured Ply Thickness, In.	1005	.005
0° FLEXURAL STRENGTH, KSI (Norms	lized to 65% ril	er volume)
RT, Dry	273	282
RT, Wet	NT	281
250°F, Dry	NT	266
250°F, Wet	177	226
350°F, Dry	197	215
350°F, Wet	63	140
0° FLEXURAL MODULUS, MSI (Normal:	lzed to 65% fibe	er volume)
RT, Dry	20.4	20.5
RT, Wet	NT	20.1
250°F, Dry	NT	19.5
250°F, Wet	19.5	20.4
350°F, Dry	20.2	19.4
350°F, Wet	10.0	18.8
SHORT BEAM SHEAR, KSI		
RT, Dry	17.7	17.1
RT, Wet	NT .	14.2
250°F, Dry	12.8	12.3
250°F, Wet	6.8	8.2
350°F, Dry	7.9	10.4
350°F, Wet	4.1	5.5

¹All data in this table provided by FIBERITE.

4.6 G-160/6535-1

This graphite/epoxy system was developed by AVCO and consists of a 160,000 filament graphite fiber tow (G-160) in a 350°F (177°C) epoxy matrix resin. Both the fiber and resin are manufactured by AVCO. The advantage of such a large filament tow is that prepreg costs can be considerably reduced.

Tables 75 through 87 present the data generated for this graphite/epoxy system. Figures 90 through 105 illustrate the stress-strain, fatigue, and creep behavior of this material as well as the effects of humidity aging upon selected composite properties.

The resin in this prepreg proved to be a very high flow material and it was difficult to avoid laminates with fiber content levels lower than 65-70% by volume, even with greatly reduced bleeder material and sealed layup bags. Although the acid digestion technique for determining fiber and resin content produced consistent fiber content levels of 65-73% by volume for the panels fabricated by several different layup schemes and cure schedules, photomicrographs of the laminate crosssections seemed to indicate lower fiber contents for the tested laminates.

Figure 92 presents photomicrographs of two G-160/6535-1 laminates fabricated according to different layup/curing schemes and also of a T300/V378A laminata. Pertinent laminate physical property measurements are presented for each laminate along with comments based on inspection of the photomicrographs. It would appear that the fiber packings for panels K-2 and I-19 are comparable (disregarding the voids in K-2) while that for panel K-31 is slightly less (more average space between fibers). This would infer an approximately equivalent fiber content for panels K-2 and I-19 and a lower fiber content for panel K-31. As can be observed from the data accompanying the photomicrographs, this result was not obtained experimentally. Since the fiber packing obtained for panel K-31 did not appear unreasonably dense and was

comparable to that obtained for previous materials which exhibited fiber content levels of around 65%, it was decided to proceed with the cure schedule and layup scheme used for K-31 and described in Table 75 and illustrated in Figure 90 and simply report the measured fiber contents with this commentary.

TABLE 75 PROCESSING CONDITIONS FOR G-160/6535-1 COMPOSITE LAMINATES

Composite Processing Information Material System - G-160/6535-1 Fiber - G-160 Matrix - 6535-1 Maximum Rated Temperature - 350°F(177°C) Prepreg by - AVCO

Laminate Processing Schedule

Layup Procedure: The prepreg was stored in a closed wrapper at room temperature. Prepreg was removed from wrapper and plies cut to desired size using a razor knife. Plies were stacked in the desired sequence (release paper removed from each ply). The stack was placed in the autoclave according to the layup system illustrated in Figure 90. The corprene edge dam serves to restrict fiber flow.

Cure Schedule: Apply full vacuum and heat to 265°F in 45 + 5 mins under full vacuum. Hold at 265°F for 30 mins., then apply 100 psi. Heat to 350°F in 20 +5 mins. Hold at 350°F for two hours. Cool under pressure, and vacuum, to 120°F.

Postcure Schedule: The panels were placed, unrestrained, in an oven at room temperature. The oven was brought to 375°F at rate of about 5°F/min. After a four-hour hold at 375°F, the oven was turned off. When the oven was cooled to near room temperature, the panels were removed.

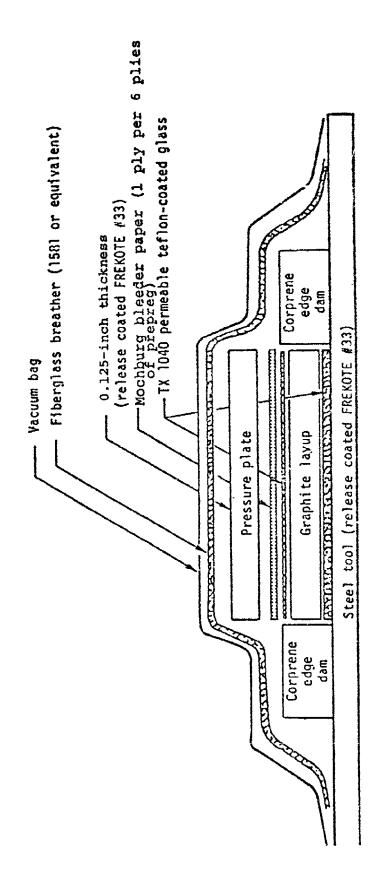


Figure 90. Layup System for AVCO 6535-1 Laminates.

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TABLE 76
PREPREG AND COMPOSITE PHYSICAL PROPERTIES

Material System - G-160/6535- Fiber - G-160 Matrix - 6 Maximum Rated Temperature - 3	5535-1	Pre	Gr/Eg	
Prepre	g Physical I	Properties		
(Property)	(Stnd.Dev.)	(Range)	(Test Method)	(Ref.)
Volatile Content 0.20% by wt Resin Content 41.5% by wt Gel Time @ 327°F(164°C)-38.2 No. of Rolls Involved 2	t. 1.7 0.6	39.3-44.1	QCI-C-V-14 R-15 G-2	
No. of Batches Involved- 1		······································		
	e Physical I	Properties 1		***************************************
No. of Panels- 34 Fiber Content- 68.4% by vol.	(Stnd.Dev.)	(Range)	(Test Method) Acid Digesti	ion
Laminate No. of Panels- 34	(Stnd.Dev.) 1.2 1.0 0.01 As rep	(Range) 66.1-71.5 22.9-27.3 1.59-1.63 ported by ma	Acid Digesti AFML-TR-67-2 D2734	ion

The properties reported here represent averages for all panels of this material used throughout the program.

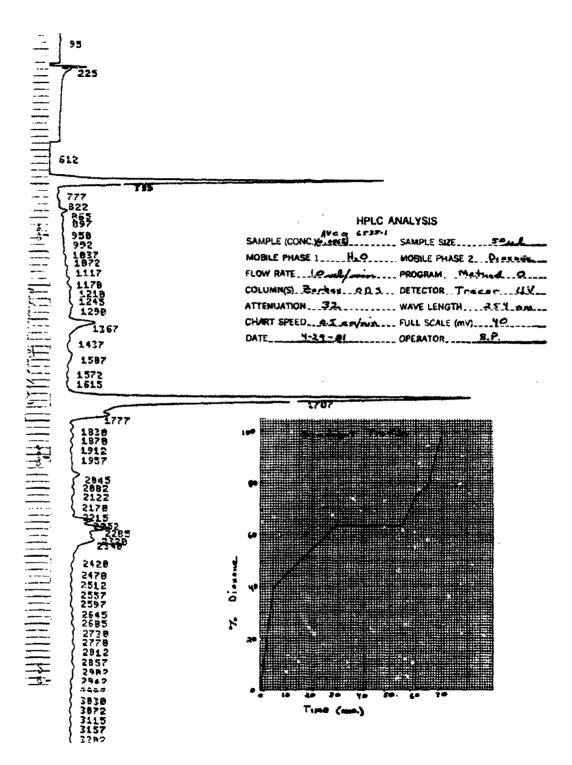


Figure 91. HPLC Analysis of AVCO 6535-1 Epoxy Resin.



(a) G-160/6535-1
PANEL K-2
EARLY CURE SCHEDULE/LAYUP SCHEME
FIBER CONTENT - 69.0% BY VOL.
SPECIFIC GRAVITY - 1.58
RESIN CONTENT - 23.8% BY WT.
VOID CONTENT - 1.2% BY VOL.
VISIBLE VOIDS



(b) G-160/6535-1
PANEL K-31
FINAL CURE SCHEDULE/LAYUP SCHEME
FIBER CONTENT - 68.5% BY VOL.
SPECIFIC GRAVITY - 1.61
RESIN CONTENT - 25.7% BY WT.
VOID CONTENT - 0
FIBER PACKING LESS DENSE THAN
FOR PANEL K 2



(c) T300/V378A

PANEL I - 19

FIBER CONTENT - 65.2% BY VOL.

SPECIFIC GRAVITY - 1.59

RESIN CONTENT - 28.2% BY WT.

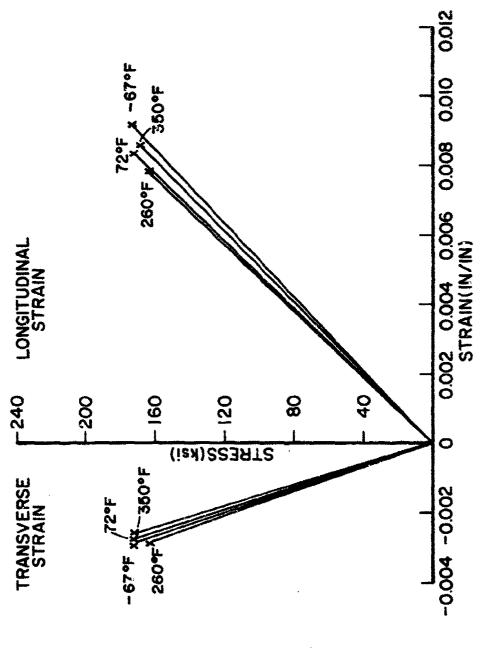
VOID CONTENT - 0

FIBER PACKING COMPARABLE TO PANEL K 2

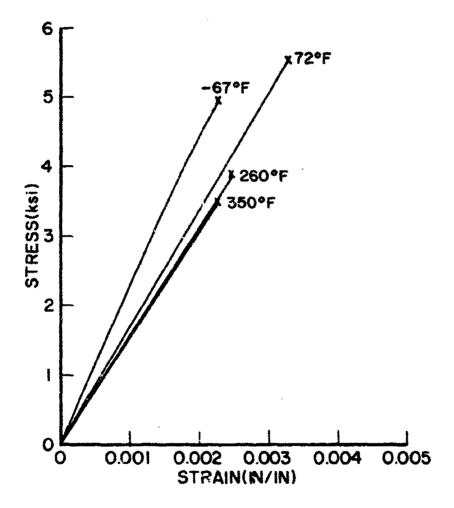
Figure 92. Photomicrographs of Composite Laminates.

TABLE 77
TENSILE PROPERTIES OF G-160/6535-1 COMPOSITE LAMINATES

	Composite	Material Properti	e#				
Material System - G16 Fiber - G-160	0/6535-1 Matrix - 6535-1	Prepreg by -		Gr/Epoxy			
'aximum Rated Tempera	ture - 350°F(177°C)	Laminate Sp. Wominal Plv	Gr 1.61 Thickness - 0.5048	inch (0.12 mm)			
Resin Content - 25.7% Fiber Content - 68.5%		No. of panel	s from which speci				
Void Content - + 04)		in this tab	le - 8				
Thickness of each type	specimen: 0* - 6	ply ; 90*	- 15 ply				
		TENSION: 0°					
	-67°¥(-55°C)	72°F(22°C)	260°F(127°C)	350°F(177°C)			
Px [ksi](MPa)	[172.4] (1188)	[167.5] (1154)	{162.6] (1120)	[171.3] (1180)			
Stnd.Dev.[ksi](MPa)	(25.7) (177)	[12.1] (83)	[7-5] (52)	(22.5) (155)			
Range (ksi)(MPa)	(148.3 - 213.8) (1022 - 1473)	[148.4 - 180.0] (1022 - 1240)	[150.0 - 168.6] (1033 ~ 1162)	[143.9 - 194.2] [991 - 1338]			
No. of Specimens	5	5	5	5			
r ^{tpl} (ksi)(MPa)	(172.4) (1188)	(167.5) (1154)	(162.6) (1120)	(166.7) (1149)			
Stnd.Dev. [ksi] (NPa)	[25.7] (177)	[12.1] (83)	[7.5] (52)	[20.7] (143)			
No. of Specimens	5	\$	\$	5			
Eg [Mai](GPa)	(18.49) (127)	(18.54) (128)	(21.11) (145)	[19.89] (137)			
Stnd. Dev. (Mai) (GPa)	[0.52] (4) S	[0.64] (4.4)	(0.68) (5) 5	[0-82] (6)			
No. of Specimens							
ε μin/in (μcm/cm)	9180	8530	7820	8390			
Stad.Dev.	1410	680	940	1210			
No. of Specimens	5 5 5						
v _{xy}	0.31	0.32	0.36	0.31			
Stad. Dev.	0.04	0.01	0.02	0.08			
No. of Specimens	5	j 5	1 5	5			
Test Mathod Straight-sided tension Reference ASTM D3039							
TEMSIOM: 90°							
F ^{tu} [ksi](MPa)	[4-93] (34)	(5.51) (38)	[3.86] (27)	(3.49) (24)			
y Stnd. Dav. [ksi] (NPa)	[0.54] (4)	[0.43] (3)	[0.53] (4)	[0.85] (6)			
Range	[4.30 - 5.43]	[5.19 - 6.15]	[3.09 - 4.43]	[2.42 - 4.41]			
No. of Specimens	(30 - 37)	(36 - 42)	(21 - 31)	(17 - 30)			
				·			
Fy (kai) (NPa)	(1.58) (11)	(5.51) (38)	[2.70] (19)	[2.42] (17)			
Stnd.Dev.[ksi] (NPa)	[0.35] (2)	[0.43] (3)	(2.74) (12)	10.641 (4)			
No. of Specimens	5	4	5	4			
Ey [GPa]	[2.27] (16)	[1.82] (13)	(1.59) (11)	(1.63) (11)			
Send.Dev.[Mai](GPa)	[0.31] (2)	(0.27) (2)	[0.21]_(1.4)	(0.111 (1)			
No. of Specimens	5	S	5	4			
ε_y^{tu} [pin/in](pow/cm)	2290	3290	2490	2270			
Stad. Dev.	510	440	380 5	780			
No. of Specimens	5	i					
v _{yx}	0.0381	0.0311	0.0271	0.0251			
Stnd. Dev.							
No. of Specimens				هنده ب			
Test Method	1	Straight-s	ided tension				
Reference		ASTM	03039				



Tensile Stress-Strain Curves for Unidirectional G-160/6535-1 Composite Laminates: 0° Fiber Orientation. 93. Figure



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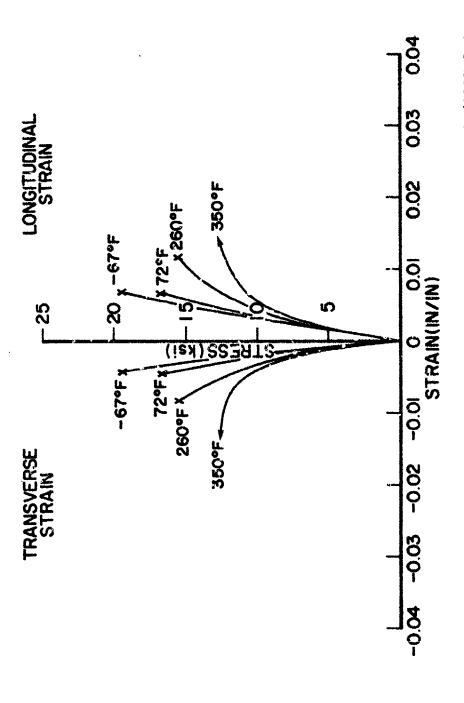
are the loss of the second of

Figure 94. Tensile Stress-Strain Curves for Unidirectional G-160/6535-1 Composite Laminates: 90° Fiber Orientation.

TABLE 73
TENSILE PROPERTIES OF G-160/6535-1 COMPOSITE IAMINATES

	Composite	Material Properti	.es		
Material System - 3-3		Prepreg by -	AVCO	Gr/Epoxy	
Fiber - 3-160 Maximum Rated Temperat Resin Content - 26.00 Fiber Content - 97.7% Void Content - 20% b	by wt. by vo	Laminate Sp. Gr 1.61 Nominal Ply Thickness - 1.304° inch(0.13 mm) No. of panels from which specimens were tested in this table - 8 Thickness of specimen - 8 plies			
	T	ENSION: +45*		and the second s	
	-67°F(-55°C)	72°F(22°C)	250°F (127°C)	350°F (177°C)	
rtu X (ksi)(MPa)	(19.43) (134)	[16.53] (114)	[15.56] (107)	[16.48] (114)	
Stnd.Dev.[ksi](MPa) Range [ksi](MPa)	[0.90] (6) [18.72-20.89] (129 - 144)	[1.17] (8) [15.36-17.77] (106 - 122)	{0.41} (?) {14.88-15.91} {103 - 110}	{1.10} (8) [15.63-17.48] (104 - 120)	
No. of Specimens	5	5	5	5	
r ^{tpl} (ksi](Mpa)	(9.53) (66)	[5.32] (41)	(4.61' (32)	[4.05] (28)	
Stnd.Dev.(ksi)(MPa) No. of Specimens	(1.96) (14) 5	{1.41} (10) 5	{0.72} (5) 5	[0.28] (2) 5	
E ^t [Msi](GPa)	(3.28) (23)	[3.12] (21)	[3.05] (21)	[2.79] (19)	
Stnd.Dev.[Msi](GPa) No. of Specimens	10.211 (1) 5	[0.12] (1) 5	[0.12] (1) 5	[0.08] (0.6) 5	
tu [μin/in] (μcm/cm)	6,890	6,940	14.520	34,800	
Stnd. Dev. No. of Specimens	1,38∪ 5	850 5	2,150 5	21	
xy	0.62	0.65	0.72	0.72	
Stnd. Dev. No. of Specimens	0.04 5	0.05 5	9.07 5	0.03 5	
Test Method Meference		•	-sided tension STM 03039		

^{&#}x27;Strain gage failed before end of test on three specimens.



Tensile Stress-Strain Curves for Bidirectional G-160/6535-1 Composite Laminates: +45° Fiber Orientation. Figure 95.

TABLE 79 TENSILE PROPERTIES OF G-160/6535-1 COMPOSITE LAMINATES

	Composite	Material Properties				
Material System - G-160/0 Fiber - G-160 Mi Maximum Exted Temperature Resin Content - N.A. Fiber Content - N.A. Void Content - N.A.	atxix - 6535-1	Prepreg by - AVCO Gr/Epoxy Laminate Sp. Gr N.A. Nominal Ply Thickness -0.0048 inch (0.12 mm) No. of panels from which specimens were tested in this table - 9 Thickness of specimen - (see footnotes)				
- 	TENSION	N: 72°F (22°C)				
	(0/±45) ³	(0/±45/90) ²	(0/±45/90) s			
rtu [ksi] (MPa)	[97.3] (670)	[91.5] (630)	[90.9] (626)			
Stnd. Dev. [ksi] (MPa) Range [ksi] (MPa)	[6.0] (41) [88.3 - 103.2] (608 - 711)	[8.8] (61) [79.9 - 102.0] (551 - 703)	[6.0] (41) [84.8 - 100.7] (584 - 694)			
No. of Specimens	5	5	5			
rtpl (ksi.) (MPa)	[97.3] (670)	[91.5] (630)	[90.9] (626)			
Stnd. Dev. [ksi] (MPs) No. of Specimens	[6.0] (41) 5	[8.8] (61) 5	[6.0] (41) 5			
E [Mai] (GPa)	{11.41} (79)	[11.59] (80)	[10.92] (75)			
Stnd. Dev. [Hei] (GPa) No. of Specimens	[1.11] (8) 5	[0.67] (5) 5	[0.12] (1) 5			
tu [pin/in](pom/om)	8170	7740	8210			
Stnd. Dev. Bo. of Specimens	680 5	720 5	5 6 0 5			
v _{xv} t	0.62	0.41	0.37			
Stnd. Dev. No. of Specimens	0.04 5	0.02 5	0 .02 5			
Test Method Reference		t Straight-sided tension ASTM D3039	i			

 $[\]begin{array}{l} {}^{1}\left(0,+45,-45,0,0,-45,+45,0\right)_{8} - 16 \text{ ply.} \\ {}^{2}\left(0,90,+45,-45,0,0,-45,+45,0,0\right)_{8} - 20 \text{ ply.} \\ {}^{3}\left(0,+45,-45,0,0,-45,+45,0,90,0\right)_{8} - 30 \text{ ply.} \end{array}$

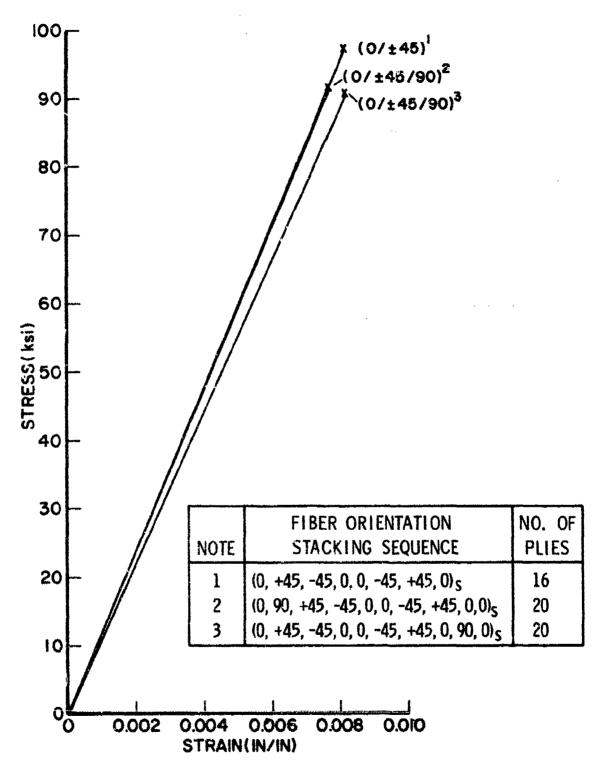


Figure 96. Tensile Stress-Strain Curves for Multidirectional G-160/6535-I Composite Laminates.

TABLE 80 COMPRESSIVE PROPERTIES OF G-160/6535-1 COMPOSITE LAMINATES

	Composite	Material Propertie)\$			
Hamis on Rated Temperat Resin Content - 23-94 Fiber Content - 70-04	ix -6535-1 ure - 350*F(177°C) by wt. by wol. by wol.	Nominal Ply (No. of panel; in this tab)	Gr 1.61 Thickness - 0.0047 from which specials - 3			
	COI	PRESSION: 0*				
· · · · · · · · · · · · · · · · · · ·	-67°F(-55°C)	72°F(22°C)	260°F(127°C)	350°F(177°C)		
F _K ^{CU} [kei](MPa) Stnd.Dev.[ksi](MPa) Range [ksi](MPa)	[214.0] (1474) [19.1] (132) [192.4 - 235.4] (1326 - 1622)	[212.3] (1463) [8.0] (55) [204.0 - 223.9] (1405 - 1543)	[188.8](1301) [20.1](138) [156.5 - 206.3] [1078 - 1421)	{151.4}(1043) [11.3] (78) {145.8 - 163.0} (1005 - 1123)		
No. of Specimens	5	5	5	5		
fcpl [ksi](NFa) Stnd.Dev.[ksi](MPa) No. of Specimens	[73.9] (509) [8.6] (59) S	[105.3] (732) [33.2] (229) 5	[80,9] (557) [13,1] (90) 3	[101.9] (703) [23.2] (160) 5		
E ^C (Msil(GPa) Stnd.Dev.[Msil(GPa) No. of Specimens	[20.54] (142) [1.06] (7) 5	[19.21] (132) [1.34] (9) 5	[18.73] (129) [1.53] (11) 5	{21.40} (147) {2.45} (17) 5		
E ^{CU} [µin/in](µcm/cm) Stnd. Dev. No. of Specimens	9,520+ ¹ y ² 2,200 5	14,809+ ¹ ; ³ 3,890 5	11,060+ ¹) ⁴ 1,850 5	8,530 1,030 5		
Test Method Reference	ASTM D3410					
COMPRESSION: 90°						
r ^{CUL} [ksi] (MPa) Stnd.Dev.[ksi] (MPa) Range No. of Specimens	[36.1] (249) [6.3] (43) [29.7 - 45.5] (205 - 313) 5	[27.0] (180) [3.3] (23) [22.6 - 30.2] (156 - 208) 5	[24.0] (165) {1.3] (9) [22.0 - 25.4] (152 - 175) 5	[19.8] (136) [3.9] (27) [16.6 - 26.3] (114 - 181) 5		
g ^{cpl} [ksi](MPa) Stnd.Dav.[ksi](MPa) No. of Specimens	[14-1] (786) [4-0] (28) 5	[13.2] (91) [1.5] (10) 5	[15.9] (110) [2.8] (19) 5	[11.4] (79) [1.9] (13) 5		
E' [Mai] (GPE) Stnd.Dev.[Mai] (GPE) No. of Specimens	[2.01] (14) [0.16] (1) 5	[2.04] (14) [0.4] (3) 5	[1.40] (10) [0.11] (1) 5	[1.60] (12) [0.40] (3) 5		
E ^{CU} {µin/in}(µcm/cm) Stnd. Dev. No. of Specimens	25,730+ ¹ ; ² 5,330 5	21,960+ ^{1,6} 13,350 5	15,660+ ¹) ⁵ 6,100 5	11,750+ ¹ v ⁵ 4,490 5		
Test Method Reference		ASTH	D3410			

Ultimate strain value represents maximum observed values rather than ultimate values.

Three specimens exhibited evidence of buckling.

Two specimens exhibited evidence of buckling.

Tour specimens exhibited evidence of buckling.

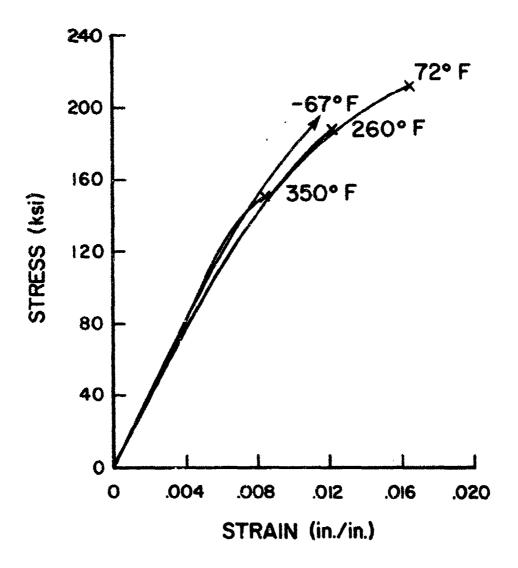


Figure 97. Compressive Stress-Strain Curves for Unidirectional G-160/6535-1 Composite Laminates: 0° Fiber Orientation.

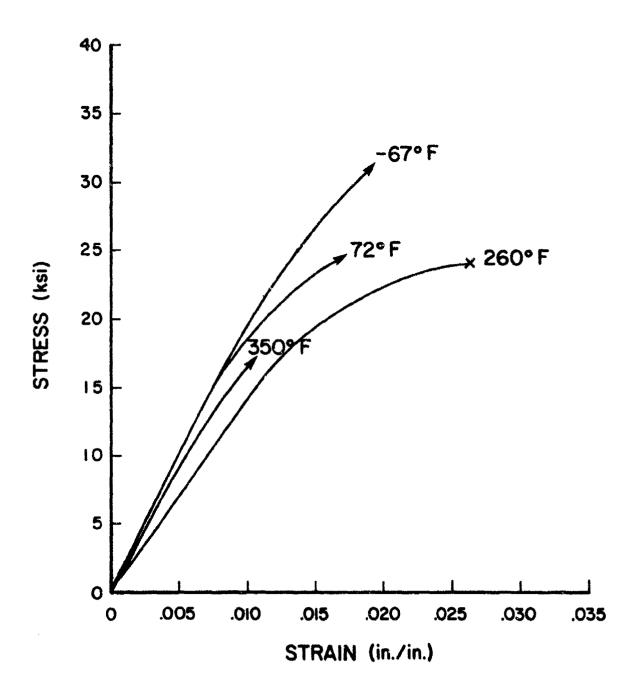


Figure 98 · Compressive Stress-Strain Curves for Unidirectional G-160/6535-1 Composite Laminates: 90° Fiber Orientation.

TABLE 81
FLEXURAL PROPERTIES OF G-160/6535-1 COMPOSITE LAMINATES

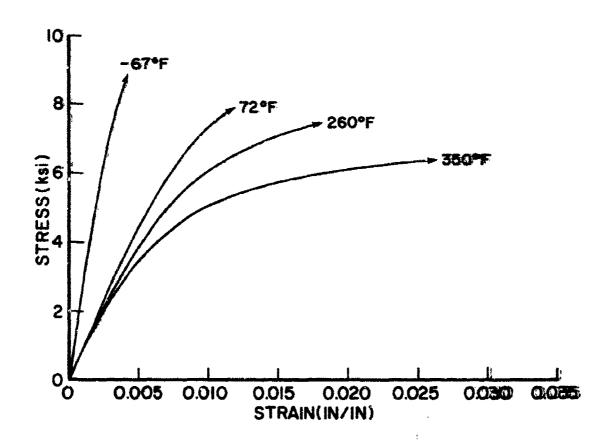
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	Composite	Material Propertie	28			
Haterial System - G-1 Fiber - G-160 Maximum Rated Tempera Resin Content - 24.8% Fiber Content - 69.6% Void Content - 20% Thickness of each type	Matrix - 6535-1 ture - 350°F(177°C) by wt. by vol. by vol.	No. of panel: in this tab	Gr 1.61 Thickness - 0.0047 G from which specia de - 2			
	1	LEXURE: 0°		~ <u> </u>		
	~67°F(~55°C)	72°F (22°C)	260°F(127°C)	350°F (177°C)		
F _x [ksi](MPa)	[239.9] (1653)	[231.3] (1594)	[219.7] (1514)	[181.7] (1252)		
Stnd.Dev.[ksi](MPa) Range [ksi](MPa) No. of Specimens	[17.2] (118) [212.3 - 255.9] [1463 - 1763) 5	[9.4] (65) [215.2 - 237.6] (1483 - 1637) 5	[4.9] (34) [214.2 - 223.5] (1476 - 1540) 3 ¹	[5.9] (53) [175.8 ~ 189.4 (1211 - 1305) 5		
Ef [Msi](GPa)	[19.04] (131)	[18.49] (127)	[18.01] (124)	[16.85] (1150)		
Stnd.Dev.[Msi](GPa) No. of Specimens	[1.19] (8) 5	[0.96] (7) 5	[0.60] (4) 3	[0.61] (4) 5		
Test Hethod Reference	3 pt. Design Guide, Jan	4 pt. 1971 - Correspondo points and	3 pt. ds to ASTM D790 exc d loading speed.	3 pt. ept for loading		
FLEXURE: 90°						
rfu [ksi](MPa)	[9.11] (63)	[8.86] (61)	[5.40] (44)	[6.50] (45)		
Stnd.Dev.[ksi](MPa) Range [ksi](MPa)	[1.75] (12) [7.09 - 10.14] (49 - 70)	(0.44) (3) [8.41 ~ 9.29] (58 ~ 64)	[0.47] (3) [4.70 - 7.78] (32 - 54)	[0.22] (2) [6.32 + 7.56] (44 - 52)		
No. of Specimens	5	5	5	5		
E _y [Msi](GPa)	[1.53] (11)	(1.45) (10)	[1.45] (10)	[1.34] (9)		
Stnd.Dev.[Msi](GPa) No. of Specimens	[0.04] (0.3) 5	[0.06] (0.4) 5	[0.04] (0.3) 5	[0.13] (1) 5		
Test Method Reference	4 pt. flexure Design Guide, Jan	correspond	s to ASTM D790 exce loading speed	pt for loading		

 $^{^{1}\}mathrm{Two}$ specimens tested in 4-point loading exhibited shear failure at a flexural stress of 163.7 ksi.

TABLE 82
SHEAR PROPERTIES OF G-160/6535-1 COMPOSITE LAMINATES

	Composite	Material Properti	es			
Material System - G-18 Fiber - C-160 Marinum Rated Temperat Resin Content - 26.79 Fiber Content - 66.99 Void Content - ± 0% Thickness of each type	Matrix - 6535-1 cure - 350°F (177°C) by wt. by vol. by vol.	No. of panel in this tab	Gr 1.60 Thickness - 0.0050 s from which speciale - 9	Epoxy inch (0.15 mm) mens were tested		
	Ti.	iplane shear				
	-67°F(-55°C)	72°F (22°C)	260°F(127°C)	350°F(177°C)		
F ^{SU} [ksi](MPa)	[9.71] (67)	[8-43] (58)	[7-77] (54)	[8.24] (57)		
xy Stnd.Dev.[ksi](MPa) Range [ksi](MPa)	[0.45] (3) [9.34 - 10.44] (64 - 72)	(0.67) (5) [7.68 - 9.00] (53 - 62)	[0.21] (1) [7.42 - 7.94] (51 - 55)	{0.55} (4) [7.54 - 8.74] (52 - 60)		
No. of Specimens	5	5	5	5		
G ^S [Msi](GPa)	[1.01] (7)	[0.94] (6)	[0.89] (6)	[0.81] (6)		
Sind.Dev.[Msi](GPa) No. of Specimens	[0.06] (0.4) [0.03] (0.2) [0.05] (0.3) [0.03] (0					
Test Method Reference	ASTM D3518					
	INT	erlaminar shear				
risu (ksi](MPa) Stnd.Dev.[ksi](MPa) Range	[16.96] (117) [1.14] (8) [15.19 - 18.21] (105 - 125)	[14.53] (100) [1.17] (8) [13.10 - 16.13] (90 - 111)	(11.90) (82) [0.47] (3) [11.36 - 12.39] (78 - 85)	[9.27] (64) [0.62] (4) [3.46 ~ 9.79] (58 - 07)		
No. of Specimens	5	10	1	ĺ		
Test Method Reference			beam shear M D2344			



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Figure 99. Inplane Shear Stress-Strain Curves for G-160/6535-1 Composite Laminates.

TABLE 83

TENSILE, COMPRESSIVE, AND SHEAR PROPERTIES OF G-160/6535-1 COMPOSITE LAMINATES AFTER HUMIDITY AGING

				Composite Material Properties	lal Properties				
Materiai System - G-160/6535-1 Fiber - G-160 Matrix - 6535-1	35-1 515-1	Prepred by Laminate Sp	- AVCO	Gr/Epoxy		(3.8.7.(3.6.)	COMPRESSION: 90" 1524 (53%)		Taknow/(1338,
Maximum Rated Temperature - 350°P Resin Content - 25.4% by wt.(177°C)	350°F	Nominel Ply	Nominal Ply Thickness - 0.0049 in.(Mominel Ply Thickness - 0.0049 in.(0.12mm)	Exposure Time (hrs)	166.5	366.5		1621
Fiber Content - 68.5% by vol.	. .	were tested	were tested in this table - 3	. 3	dry ut.)	0.62	0.63	1.22	1.27
Thickness of each time specimen.		Mying Condi	tions - 160 r	Aging Conditions - 160°F(71°C) & 180% RR	Stad. Dev. (4)	0.03	0.03	0.01	0.03
		reneron - 15 ply/ compr 20 ply/ Shear - 15 ply		'0 piyı	No. of Specimens	w.	in.	٠,	5
	TENSION	.06 ING			ry (NPA)	(kei) (MPa) (28.78] (198)	(20.58) (142)	(27.35)(188)	(17.34) (119)
	(37.60)				Stnd. Dev. [kel] (MPc) [1.84] (13)	11.84) (13)	(11.48) (10)	(2.73) (1.9)	(1.16) (8)
Exposure time (hrs)	3000	(3,25) 17.27 (3,25)	(3.22.27	B60*F 127*C)	Range	(25.85-30,65)	[18,37-22,33]		[16.17-18.74]
Mt. Gain(a of oxig. 0.67	67	0.69	9000	aarr .	Mo. of Specimens	(11.5 = 211)	(127 - 154)	(160 - 200)	(111 - 129)
	20	0.03	0.01	1.29	•	1	١	'n	ın.
No. of Specimens		sn.	25	2.5	FUP. [ket] [Ma) [9.07]	(63) (63)	(69.59) (48)	(11.96)(82)	(3.32) (23)
Ptu [kal] (NPa)[3.84] (26)	1 (26)	(13.41) (17)	(27.18) (15)	(1).59} (1)	Sind. Dev: [ket](1Pa)[5.07]	(5.07] (35)	(01) [05.1]	(3.57) (25)	(6.67] (5)
Stnd. Dev. [heil (spa)[0.33] (2)	(2)	[0.29] (2)	(0.34) (2)	(0.06) (0.4)			1	,	Α.
Fange	-4.14]	[1.93-2.62]	[1.72-2.56]	(1.52-1.67)	(Mat) (CPA)	(Mail (CPa) (1.81) (12)	(11-41) (10)	11.623 (11)	(11.61) (11)
No. of Specimens 5	Ì.	(8) 2 (8)	(12 - 18)	(10 - 12)	Stnd. Dev. [Mai] (GPa) [0.06]	(0.06) (0.4)	(0.13) (1)	(1) (1)	(1) [80.0]
#tpl [kei] (MPa)(3.64] (26)	(52)	(11.71) (12)	(2.18) (15)	(0.58) (4)	ECU luto/inj luca/ca)	22 gant	1	,	n
Stud. Dav. [ksi] [HPa][0.33] (2)	(3)	(0.26)	10.34) (2)	(0.121 (1)	Strd Dev.	S 610	087.67	26,540	26,740
No. of Specimens	\ G	in.	· ·	5 5	No. of Specimens	24.6	2,0,70	5,000	8,710 5
EX [Me1] (GPa)[1.69] (12)	(13)	(01.45) (10)	(11.65) (11)	(1.24) (9)	Test Hethod		_	_	1
Stad. Dav. [Mai] GPai[O.II] (1)	3	(0.28) (2)	(1) [91'0]	(0.13) (1)	Asterance		Y	ASTM D3410	
		,	en.	th.		XX.A.	THE SECONDAR SHEAR		
ctis (pin/in) (pen/os) 220	2280	1900	1320	1570	Exposure Time (hrs)	93	16	1,530	1,930
Stud. Dev.	179	430	750	150	dry wt.)	0.55	0.56	51.1	1.13
		vn	w.	ζ.	Stnd. Dav. (1)	80.0	0.07	0.15	0.11
Test Method Feference		Straight-si	Straight-sided tension		1819	2	n	10	v
			65050		Dav. (kel) (MPa)	[kel] (wes) [14.26] [98] [kel] (wes) [0.52] [.)	19.281(64)	[12.33] (65) [0.73] (5]	[6.52] (45) [0.14] (1)
					Specimens	(93 - 10¢)	(58 - 68) 58 - 68)	(75 - 91) (75 - 91) 10	[6.28-6.62] (43 - 46)
					Test Method	•	AST	AST# D2344	
				7	AST OF UNCO			. :	

 1 One specimen exhibited evidence of buckling.

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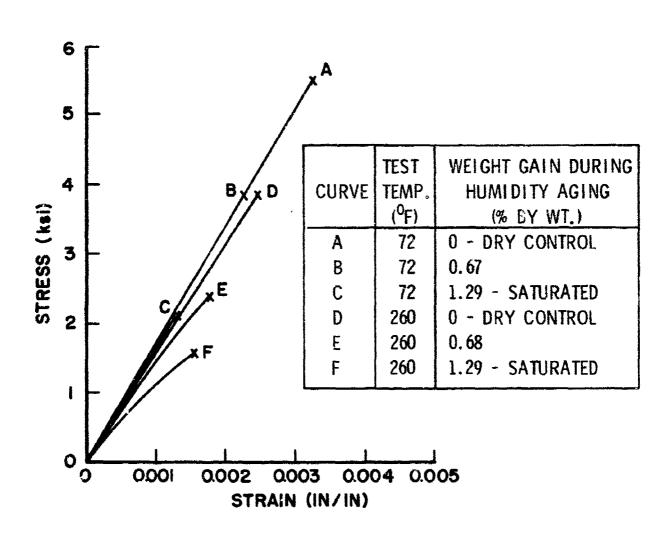
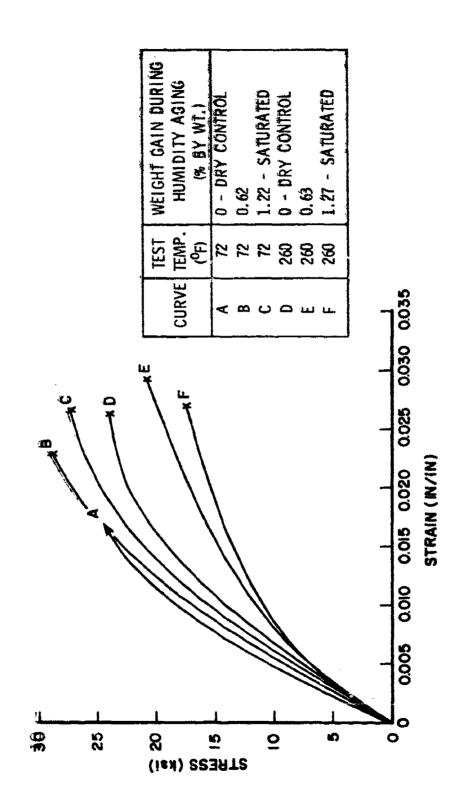


Figure 100. Tensile Stress-Strain Curves for Unidirectional G-160/6535-1 Composite Laminates After Humidity Aging: 90° Fiber Orientation.



Compressive Strefs-Strain Curves for Unidirectional Composite Laminates After Humidity Aging: 90° Fiber Orientation. Figure 101.

TABLE 84

CREEP PROPERTIES OF G-160/6535-1 COMPOSITE LAMINATES

Composite Material Properties							
Fiber - G-160 Naximum Tempe	Enture Sating -350°F(177°C)	France by - AVCO Gr/Ep Laminate Sp. Gr 1.61 Nominal Ply Thickness - 0.0048 inch(0.12 mm)					
Fiber Content Void Content	: - 26.2% by wt. : - 67.8% by wol. 0% by wol. - Straight-sided tension	No. of panels from which specimens were tested in this table - 18 Thickness of each type specimen: +45° - 8 ply 0/+45/90² - 20 ply					
Reference - 1	STM D2290 and D3039	0/ <u>+</u> 45* ³ - :	le ply 0/4	45/90 ³ - 20 p	ly		
-		CMFE					
Temperature	Fiber Orientation .	±45*	0/+45	0/145/902	0/±45/903		
72°¥(22°C)	Stress Level[ksi](APa) Creep Strain, 500 hr(4) No. of Specimens Residual Strength(ksi](APa) No. of Specimens	(13.22) (91) 0.2497 3 [18.17] (125) 3	0.0073 2 ⁶	[72.70] (501) 0.0164 2 ⁵ [109.84] (757) 2	[77.83] (536) 0.0102 2 ⁶ [113.85] (784) 2		
	Stress Level(Lei](MPs) Creep Strain, 500 hr(%) No. of Specimens Residual Strength(ksi)(MPs) No. of Specimens	(11.57) (80) 0.2031 3 (19.30)(5.23)	0.0171	0.0148	0.0122		
	Stress Level [kmi] (K/m) Cresp Strain, 500 hr(%) No. of Specimens Residual Strength [kmi] (MPm) No. of Specimens	(9.921(68) 0.1124 3 (19.24)(133					
260°F(127°C)	Stress Level[ksi](MPa) Creep Strain, 500 hr(%) No. of Specimens Residual Strength(ksi](MPa) No. of Specimens	(12.45] (86) 3 (14.68)(001) 2 ⁶					
	Stream Hawel(kmi)(MPm) Creep Strain, 500 hr(%) No. of Specimens Residual Strength(kmi)(MPm) No. of Specimens	(10.89) (75) 3424 ³ 2 (16.39)(113 2 ⁶					
	Stress Level[kei] (MPm) Creep Strain, 500 hr(%) No. of Specimens Residual Strength[ksi] (MPm) No. of Specimens	(9.44) (65) 0.2520 3 (16.25)(112)					
350°F(177°C)	Stress Level[ksi](MPa) Creep Strein; 500 hr(%) Mn. of Specimens Residual Strength[ksi](MPa) Mo. of Specimens	[11.54] (80) 1.9939 15 [16.01](110) 3					
medical de la companya de la company	Stress Level(kei)(MPa) Creep Strain, 500 hr(%) No. of Specimens Residual Strength(kei)(MPa) Wo. of Specimens	[9.89] (68) 2.3224 1 ⁵ [17.01](117] 3			_		
The same of the sa	Stress Level(kei](MFw) Creep Strain, 500 hr(%) No. of Specimens Meaidus Strength(kei](MFw) Mo. of Specimens	(8.24) (57) 1.7352 147 [15.88]109					

^{1(0,45,-45,0,0,-45,45,0)}g-16 gly
2(0,45,-45,0,0,-45,45,0,90,0)g-20 ply
1(0,90,45,-45,0,0,-45,45,0,0)g-20 ply
Strain gages failed on three specimens during test.

Strain gages failed on two specimens during test.

*One specimen failed during test.

*One specimen overheated.

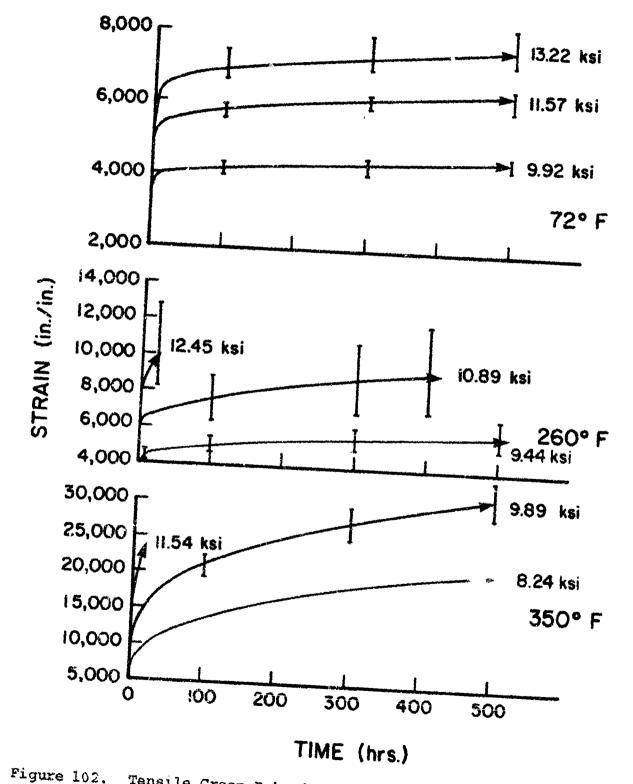


Figure 102. Tensile Creep Behavior of G-160/6535-1 Composite Laminates: +45° Fiber Orientation.

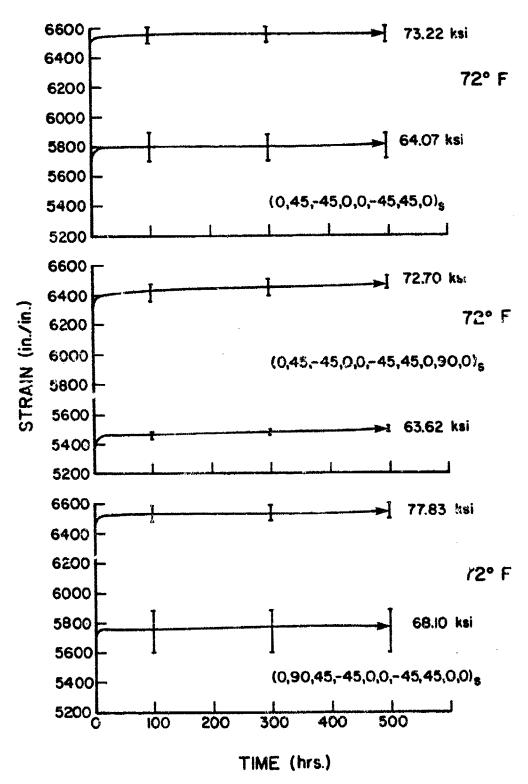


Figure 103. Tensile Creep Behavior of Multidirectional G-160/6535-1 Composite Laminates.

TABLE 85

STRESS-RUPTURE BEHAVIOR OF G-160/6535-1 COMPOSITE LAMINATES

Composite Material Properties									
Haterial System - G-160/6535-1 Fiber - G-160 Matrix - 6535-1 Maximum Temperature Rating - 350°F(177°C) Resin Content - 26.2% by wt. Fiber Content - 67.8% by vol. Void Content - *0% by vol. Test Method - Straight-sided tension Reference - ASTM D2290 and D3039 Prepreg by - AVCO Gr/Ep Laminate Sp. Gr 1.61 Nominal Ply Thickness - 0.0048 inch(0.12 mm) No. of panels from which specimens were tested in this table - Thickness of each type specimen: +45 - 8 ply 0/+45/90° - 20 ply 0/+45° - 16 ply 0/+45/90° - 20 ply									
STRESS RUPTURE									
Temperature	Fiber Orientation	<u>+4</u> 5	0/+451	0/+45/902	0/ <u>+</u> 45/90 ³				
72°F(22°C)	Stress Level[ksi](MPa) Time to Failure(hrs) No. of Specimene Residual Strength[ksi](MPa) No. of Specimens Stress Level[ksi](MPa) Time to Failure(hrs) No. of Specimens Residual Strength[ksi](MPa) No. of Specimens	3 [11.57](80) 503+ 3	[73.22] (504) 369+ 3 (108.40](747) 2. [64.07] (441) 510+ 3 [103.46] (713)	2	333+ 3 [113.85] (784) 2 [68.10] (469) 503+ 3				
260 °F(127°C)	Stress Level[ksi](MPa) Time to Failure(hrs) No. of Specimens Residual Strength[ksi](MPa) No. of Specimens Stress Level[ksi](MPa) Time to Failure(hrs) No. of Specimens Residual Strength[ksi](MPa) No. of Specimens	[12.45] (86) 351+ 3 [14.68] (101) 2 [10.89] (75) 482+ 3 [16.39] (113) 2							
350°F (177°C)	Stress Level[ksi](MPa) Timp to Failure(hrs) No. of Specimens Residual Strength[ksi](MPa) No. of Specimens Stress Level[ksi](MPa) Time to Failure(hrs) No. of Specimens Residual Strength[ksi](MPa) No. of Specimens	[11.54] (80) 500+ 3 [16.01] (110) 3 [9.89] (68) 500+ 3 [17.01] (117)							

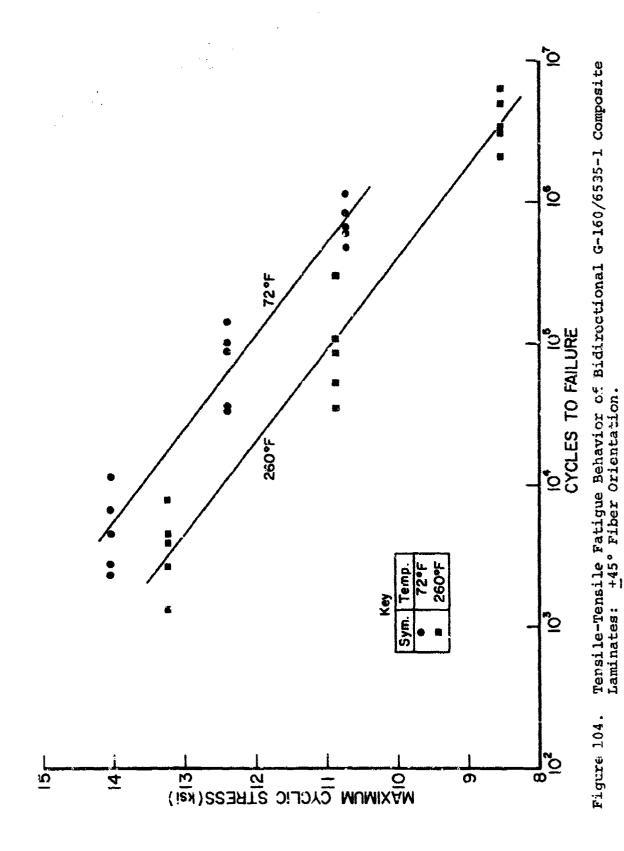
^{1(0,45,-45,0,0,-45,45,0)&}lt;sub>8</sub> - 16 ply 2(0,45,-45,0,0,-45,45,0,90,0)₈ - 20 ply 3(0,90,45,-45,0,0,-45,45,0,0)₈ - 20 ply

TABLE 86

TENSILE-TENSILE FATIGUE PROPERTIES OF G-160/6535-1 COMPOSITE LAMINATES

Composite Material Properties								
Mater (al System + G=160/6535-1 Propreg by - AVCO Gr/Zr Fiber - G-160 Matrix - 6535-1 Maximum Temperature Rating - 350°F(177°C) Resin Content - 26.21 by wt. Filer Content - 67.82 by vol. Void Content - = 0% by vol. Test Method - Straight-sided tension Resin D3039 G/+45¹ - 16 ply 0/-45/90¹ - 20 ply								
TENSILE PATIGUE, R=0.1								
Temperature	Piber Oxientation	+45	0/+451	0/ <u>+</u> 45/90 ²	0/ <u>+</u> 45/90 ³			
72°F (22°C)	Max. Strers[ksi] (MPa) Lifetime (cycles) No. of Specimens Residual Strength[ksi] (MPa) No. of Specimens Max. Stress[ksi] (MPa) Lifetime (cycles) No. of Specimens Residual Strength[ksi] (MPa) No. of Specimens Max. Stress[ksi] (MPa) Lifetime (cycles) No. of Specimens Kasidual Strength[ksi] (MPa) Lifetime (cycles) No. of Specimens Residual Strength[ksi] (MPa) No. of Specimens	[14.05](97) 4,603 5 0 [12.40](85) 69,314 5 0 [10.74](74) 719,082 5 0	[87.55] (603) 1,259 5 0 [82.69] (570) 22,478 5 0 [77.82] (536) 45,079 5 0	[86.39] (595) 962 5 0 [81.79] (564) 47,309 5 0 [77.25] (532) 154,164 5 0	[77.79] (536) 1,767 5 0 [73.22] (504) 99.022 5 0 [68.64] (473) 125,270 5 0			
260°F(127°C)	Max. Stress[ksi] (MPa) Lifetime (cycles) No. of Specimens Residual Strength[ksi] (MPa) No. of Specimens Max. Stress[ksi] (MPa) Lifetime (cycles) No. of Specimens Mesidual Strength[ksi] (MPa) No. of Specimens Max. Stress[ksi] (MPa) Lifetime (cycles) No. of Specimens Residual Strength[ksi] (MPa) Lifetime (cycles) No. of Specimens Residual Strength[ksi] (MPa) No. of Specimens	[13,23](91) 3,438 5 0 [10,89](75) 138,999 5 0 [8,56](59) 3,640,227 5 0						

 $[\]frac{1}{2}(0,45,-45,0,0,-45,45,0)_{S} - 16 \text{ ply}$ $\frac{2}{2}(0,45,-45,0,0,-45,45,0,90,0)_{S} - 20 \text{ ply}$ $\frac{1}{3}(0,90,45,-45,0,0,-45,45,0,0)_{S} - 20 \text{ ply}$



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Tensile-Tensile Fatigue Behavior of Multidirectional G-160/6535-1 Composite Laminates. Figure 105.

TABLE 87
THERMOPHYSICAL PROPERTIES OF G-160/6535-1
COMPOSITE LAMINATES

	Compos	ite Material	Properties				
Material System - G-160/c Fiber - G-160 Matrix Maximum Temperature Rating Resin Content - 25.5% by w Fiber Content - 68.5% by v Void Content - = 0% by vo Thickness of each type spe	Gr/Epoxy inch(0.12 mm) mens were tested ply 8 ply						
THERMOPHYSICAL PROPERTIES: 0°							
	-67°F(~55°C)	72*F(22*C)	260°F(127°C)	350°F(177°C)	Test Method		
Thermal Expansion ¹ o _x [µin/in-*f](µcm/cm-°C)					TMA ²		
α _y [μin/in-*F]{μcm/cm-*C) No. of Specimens per direction	[12.5] (22.5) 3	[13.8] (24.8) 3	(16.7) (30.0)	[18.0](32.4)			
-p	[0.154] (644) 3	[0.202](845) 3	[0.281](1175) 3	[0.333](1393) 3	DSC ³		
No. of Specimens Thermal Conductivity ¹ k _z [btu-ft/ft ² -hr-°F] (W/m-°C) No. of Specimens	[0.23] (0.40) 3	[0.38] (0.66) 3	[0.57] (0.99) 3	(0.66) (1.14)	Comparative		
Glass Transition Temp. Dry [*F](*C) [507] (264) Wet [*F](*C) [471] (244)			э м.⁴				
THERMOPHYSICAL PROPERTIES: ±45°							
Thermal Expansion 1 α_{χ} [µin/in-*F] (µcm/cm-*C)	(1.63](2.93)	[1.37](2.46)	{1.24](2.24)	[1.41](2.54)	tha ²		
No. of Specimens per direction	3	3	3	3			
Thermal Conductivity ¹ k _z [btu-ft/ft ² -hr-*F] (W/m-*C) No. of Specimens	[0.37] (0.64) 3	[0.43] (0.74) 3	(0.51) (0.88) 3	[0.55] (0.95) 3	Comparative		

NOTES:1. On the unidirectionally reinforced specimens, the x-direction is along the fiber axis, the y-direction is across the fiber axis, and the z-direction is through the thickness (identical to the y-direction). On +45° bidirectionally reinforced specimens, the x and y directions are identical and oriented at 45° to either fiber direction, while the z-direction is through the thickness.

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^{2.} Thermo-mechanical Analysis.

^{3.} Differential Scanning Calorimetry.

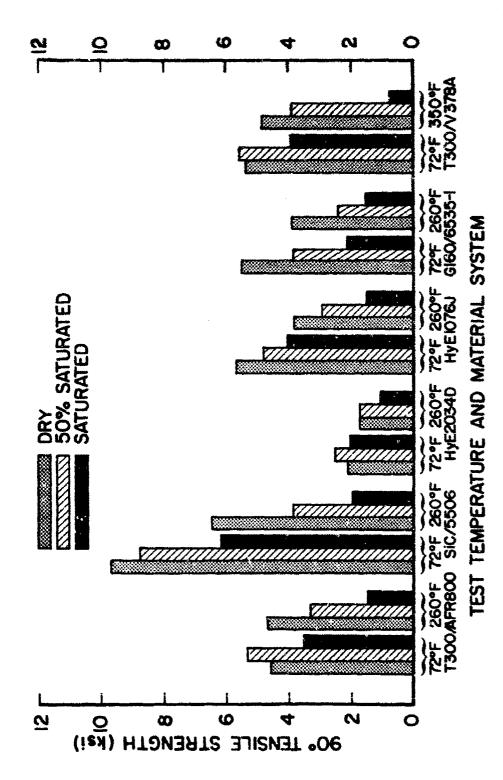
^{4.} Dynamic Mechanical Analysis.

4.7 COMPARATIVE ENVIRONMENTAL BEHAVIOR

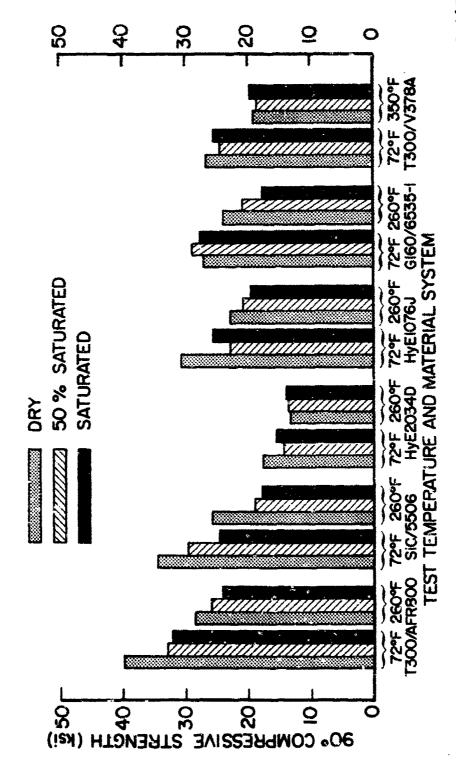
One of the points of particular interest relative to the data generated in this program is the comparative susceptibility of the different composite materials to degradation during, or as the result of, elevated temperature, high humidity aging. Figures 106 through 108 illustrate the effect of both test temperature and moisture absorption upon the strength retention of these composite materials. The notations "saturated" and "50% saturated", recall, refer to the specimen condition just prior to testing. As discussed in Section 3.4, the specimens tested at elevated temperature undoubtedly dry out to some extent during the testing process, with the smaller specimens (shear and compression) drying out more rapidly than the larger tensile specimens.

Additionally, use of the description, "50% saturated", refers to the partial saturation condition. While the aging periods were selected so as to effect about 50% as much moisture absorption as is present at equilibrium, the actual levels of partial saturation range from 45-67% of the fully saturated levels. Further, it must be recognized that while a specimen permitted to reach an equilibrium saturation condition may have a relatively uniform moisture concentration throughout its thickness, one only "50% saturated" will have most of that moisture concentrated near the surfaces.

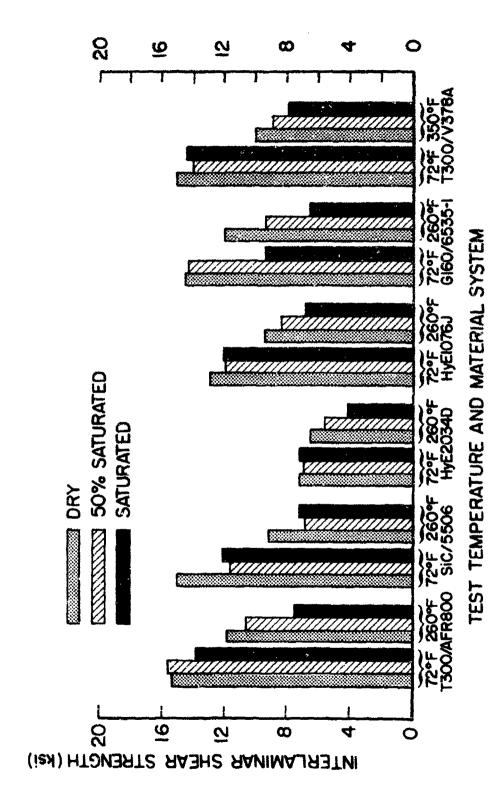
Several features in Figures 106-108 stand out. First, the strength levels for the HyE 2034D system (employing the 75 Msi [517 GPa], pitch-based graphite fiber) are lower for every type of test and for every temperature and moisture level than any of the other materials. This is probably due to a lower level of interfacial bonding between this particular reinforcing fiber and the 934 epoxy matrix. Relative to the strength levels in the dry material, the HyE 2034D system loses the least strength due to absorbed moisture of any of the other five materials. This, however, is probably the result



Comparative Transverse Tensile Strength Retention After Aging at 160°F(71°C) and 100% Relative Humidity. Figure 106.



Comparative Transverse Compressive Strength Retention After Aging at $160\,^{\circ}$ F (71°C) and $100\,^{\circ}$ Relative Humidity. Figure 107.



Comparative Interlaminar Shear Strength Retention After Aging at 160°F (71°C) and 100% Relative Humidity. Figure 108.

of the original below average interfacial bond strengths since the wet strength levels of the other epoxy-matrix systems are comparable to the dry strength level of the HyE 2034D.

Second, while the SiC/5506 system loses the most strength, relative to the dry state, of any of the materials tested, its absolute strength levels in 90° tension are clearly the highest and its absolute strength levels in 90° compression and interlaminar shear are comparable to the other materials.

In those instances in which a more saturated condition resulted in a higher strength than a less saturated condition, the difference is small enough to be attributable to experimental scatter.

While the fact that the T300/V378A system (polyimide) was tested at 350°F (177°C) rather than 260°F (127°C) makes it less than straightforward to compare it directly with the other five systems (all epoxy), it would appear, with the possible exception of the 350°F (177°C) saturated condition, that this material suffers less degradation due to moisture absorption than any of the other materials tested.

Elevated temperature, high humidity agings similar to those conducted during this program were previously carried out on two other polyimide systems, AS/4397 by Hercules, and T300/F178 by Hexcel, and reported in AFML-TR-77-151. [14] Comparison of the 90° tension and interlaminar shear data (both dry and humidity aged) of these two materials with that for the T300/V378A system reveals that the latter material exhibits generally equivalent or superior strength levels to either of the two systems tested earlier. This in spite of the fact that the latter material had a void content of about 0.8% while the two earlier materials were void free.

SECTION 5 CONCLUSIONS

Each of the conclusions listed in this section was arrived at through inspection of the data in Section 4 and represent generalizations of overall composite behavior. Exceptions to each of these generalized conclusions can be found if the data are scrutinized in sufficient detail. In most cases, these exceptions are at least mentioned and discussed.

- 1. The static strengths (tensile, compressive, flexural, inplane, and interlaminar shear) of each material evaluated in this program decreased with increasing test temperature. In those cases where this was not true, the exception usually proved to be either in a tensile specimen dominated by 0° plies, or at -67°F (-55°C). The latter situation most probably is due to increased sensitivity to brittle failure at the lower temperature.
- 2. In those cases where the elastic modulus is primarily fiber dependent, the test temperature had relatively little effect on the modulus (0° tension, 0/±45/90 tension, 0° compression, 0° flexure). In those cases where the composite modulus is primarily matrix dependent, however, the modulus for each material decreased with increasing temperature just as the strengths did.
- 3. The ultimate elongations of the fiber dependent specimens behaved in roughly the same fashion as the strength, and with the same exceptions. The ultimate elongations of the matrix dependent specimens (90° and ±45° tension and 90° compression) increased with increasing temperature for any specific stress. Since the ultimate stress for these specimens, however, was simultaneously decreasing, the actual ultimate elongations for these type specimens exhibited some increases and some decreases with increasing test temperature.

- 4. On those systems in which holes were drilled in the center of the multidirectional tensile specimens, the static tensile strength was 76-80% of what it would have been had it followed the reduction in cross-sectional area directly. This reduction is probably due to the creation of a stress concentration around the hole (diameter = 0.1935 x width of specimen).
- 5. On the last material tested, the presence, absence, and location of a 90° ply in the layup stack was varied because of its influence on normal edge stresses. The static tensile results indicated that the layup with a low level of normal edge stress produces a slightly higher tensile strength, while the layups which produce large tensile and large compressive edge stresses produce equivalent, and slightly lower tensile strengths. In fatigue, the layup which produces large tensile edge stresses and the stress-free layup exhibit longer lifetimes, for equivalent cyclic stress levels, than the layup which produced large compressive edge stresses. The former two layups (stress-free and tensile edge stress) exhibit comparable fatigue behavior. The difference in slope may be insignificant considering the limited amount of available data and the degree of scatter.
- 6. The thermal conductivity and specific heat increased with increasing temperature for all six systems.
- 7. The coefficient of thermal expansion (CTE) seemed relatively independent of temperature for the four systems incorporating high strength graphite fiber. On the HyE 2034D system, however, incorporating a high

modulus graphite fiber, the CTE decreased with increasing temperature while the system incorporating silicon carbide fiber exhibited an increasing CTE with temperature.

8. On all of the graphite reinforced systems, the layups incorporating 0° plies exhibited considerable scatter in fatigue lifetimes. The silicon carbide reinforced system, on the other hand, exhibited much less scatter in fatigue lifetimes on layups incorporating 0° plies. Along with the greater scatter in the graphite systems, however, these systems exhibited considerably longer fatigue lifetimes than the silicon carbide system at comparable cyclic stress levels.

For the ±45° orientations, there was relatively little scatter on any of the materials. For this orientation, the high strength graphite systems again exhibit considerably longer fatigue lifetimes than the silicon carbide system for comparable cyclic stress levels. The high modulus graphite system outperforms the silicone carbide system in fatigue for the ±45° orientation if the cyclic stress levels are converted to percent of static tensile strength.

9. The relatively large plastic strains undergone by the ±45° orientation led, in some cases, to substantial internal energy dissipation and self-heating in fatigue tests. For the materials tested here, this self heating caused typical temperature increases in ±45° orientations of 8-20°F (4-11°C) for cyclic stress levels in the range of 60-85% of the static ultimate. There were some specimens of course that exhibited practically no self heating while others exhibited temperature rises of up to 40°F (22°C).

10. Probably the most unusual thing observed in the creep testing was the tendency of some of the multidirectional layups (0/±45/90), particularly at elevated temperature and with the high modulus graphite fiber, to exhibit contraction rather than extension. This was not observed with the silicon carbide system. It may be attributable to the gradual relief of residual internal stresses resulting from lamipate fabrication.

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APPENDIX A

COMPUTATION OF NORMAL EDGE STRESSES

It is well known that a flat composite laminate which is subjected to a basically in-plane system of loads can develop normal interlaminar stresses near free edges that are sufficient to cause delamination. This phenomenon occurs because a composite laminate is not a two-dimensional structure at all, but is a complex, non-homogeneous, three-dimensional system. In a macromechanical sense a composite laminate distributes loads much like a plate composed of a single homogeneous material. In the center of a laminate structure, at points distant from boundaries and points of load applications, the macromechanics theory of composites is sufficient to represent the state of stress accurately. However, near boundaries such as the free edges of a tension specimen, the state of stress is three-dimensional and depends on the laminate stacking sequence. In particular, interlaminar normal stresses at a free edge can be so affected by stacking sequence that changes in sign may occur simply by rearranging the layers.

This Appendix presents a brief discussion of the procedure used for analytically determining the interlaminar normal edge stresses in a composite tensile specimen. The method involves the following two steps:

- (1) Computation of the nominal stresses in each layer using macromechanics composite theory, as presented in References 15 and 16, and;
- (2) Estimation of the normal stresses between individual lamina, according to the method presented in References 17-19.

These analysis steps are discussed individually below in Sections A.1 and A.2. Section A.3 contains interlayer normal stresses computed for example composite tensile layups of various materials.

A.1 LAYER STRESSES

The nominal layer stresses in a composite laminate are computed by means of standard macromechanics theory. For completeness, the relevant equations are presented below for a general laminated composite; the special case of narrow test specimens with free edges will be considered in Section A.2

A.1.1 Stress Resultants

It is presumed that a stress analysis has been performed on a composite plate (we will specialize to the case of a tension specimen in Section A.2) referred to a two-dimensional Cartesian coordinate system x,y; that is, at every point x,y, the in-plane stress resultants N_x , N_y , N_{xy} and the moment stress resultants M_x , M_y , M_{xy} have been determined (by plate theory, from a finite element analysis, by experimentation, etc.). These stress resultants arise from a system of mechanical and thermal loads, and they act at a reference plane (usually the middle surface) with the positive conventions shown in Figure A-1.

A.1.2 Lamina Properties

The x,y coordinate system of Figure A-1 is referred to as the structural axes. An individual lamina is referred to a 1,2 set of material axes as shown in Figure A-2. The lamina fibers are oriented along the material 1-axis which is measured relative to the structural x-axis by the angle θ . The in-plane material properties of the lamina are referred to by:

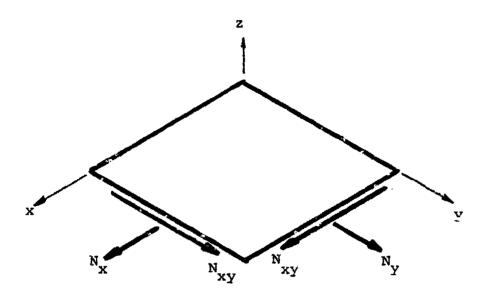
Moduli of elasticity: E_1 , E_2 Poisson's Ratio : v_{12} , $v_{21} = \frac{E_2}{E_1} v_{12}$

Shear Modulus : G₁₂

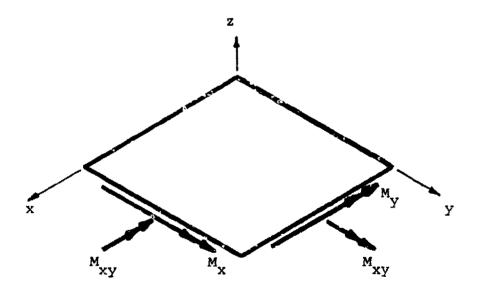
Thermal Coefficients: α_1 , α_2

The stress-strain relationship for the lamina is written as

$$\begin{pmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_{12} \end{pmatrix} = [Q] \begin{cases} \epsilon_1 - \alpha_1 \Delta T \\ \epsilon_2 - \alpha_2 \Delta T \\ \epsilon_{12} \end{cases}$$
(A.1)



Membrane Stress Resultants



Bending Stress Resultants

Figure A-1. Stress Resultants at the Mid-Surface of a Composite Laminate.

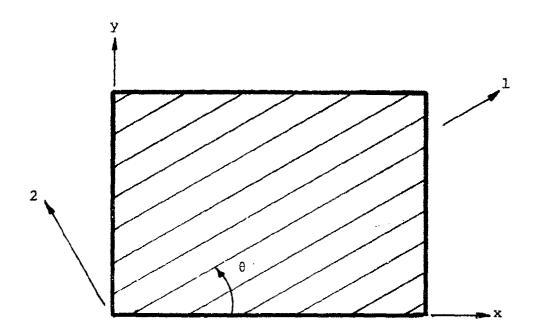


Figure A-2. Typical Lamina.

where AT is a change in temperature, and

$$[Q] = \begin{bmatrix} Q_{11} & Q_{12} & 0 \\ Q_{21} & Q_{22} & 0 \\ 0 & 0 & Q_{66} \end{bmatrix}$$
 (A.2)

where.

$$Q_{11} = \frac{E_1}{1 - v_{12} v_{21}}$$

$$Q_{22} = \frac{E_2}{1 - v_{12} v_{21}}$$

$$Q_{12} = Q_{21} = \frac{v_{12} E_2}{1 - v_{12} v_{21}} = \frac{v_{21} E_1}{1 - v_{12} v_{21}}$$

$$Q_{66} = G_{12}$$
(A.3)

If the lamina material properties are referred to the structural axes rather than the material axes, the following transformations are performed:

$$[\bar{Q}] = [T]^{-1}[Q][T]^{-T}$$
 (A.4)

$$\begin{pmatrix} \alpha_{\mathbf{x}} \\ \alpha_{\mathbf{y}} \\ \alpha_{\mathbf{xy}} \end{pmatrix} = \begin{bmatrix} \mathbf{T} \end{bmatrix}^{\mathbf{T}} \begin{pmatrix} \alpha_{1} \\ \alpha_{2} \\ 0 \end{pmatrix} \tag{A.5}$$

where the transformation matrix is given by

$$[T] = \begin{bmatrix} \cos^2 \theta & \sin^2 \theta & 2\sin\theta\cos\theta \\ \sin^2 \theta & \cos^2 \theta & -2\sin\theta\cos\theta \\ -\sin\theta\cos\theta & \sin\theta\cos\theta & \cos^2 \theta\sin^2 \theta \end{bmatrix}$$
 (A.6)

and its inverse is,

$$[T]^{-1} = \begin{bmatrix} \cos^2\theta & \sin^2\theta & -2\sin\theta\cos\theta \\ \sin^2\theta & \cos^2\theta & 2\sin\theta\cos\theta \\ \sin^2\theta\cos\theta & -\sin\theta\cos\theta & \cos^2\theta-\sin^2\theta \end{bmatrix}$$
(A.7)

A.1.3 Laminate Properties

Consider a laminate formed by stacking individual laminae as shown in Figure A-3. A typical lamina is referred to by "k". For example, the thickness of layer k is h_k and the transformed material property matrix is $\{\bar{Q}\}_k$.

The stress-strain relationship for a laminate in terms of the reference surface stress resultants (N_X, N_Y, N_{XY}, M_X, M_Y, M_{XY}) computed as indicated in Section A.1, and the reference surface strains (ϵ_{XO} , ϵ_{YO} , ϵ_{YO}) and curvatures (ϵ_{XY} , ϵ_{YY} , ϵ_{XY}) is given by

$$\begin{bmatrix} A_{11} & A_{12} & A_{16} & B_{11} & B_{12} & B_{66} \\ A_{12} & A_{22} & A_{26} & B_{12} & B_{22} & B_{26} \\ A_{16} & A_{26} & A_{66} & B_{16} & B_{26} & B_{66} \\ B_{11} & B_{12} & B_{16} & D_{11} & D_{12} & D_{16} \\ B_{12} & B_{22} & B_{26} & D_{12} & D_{22} & D_{26} \\ B_{16} & B_{26} & B_{66} & D_{16} & D_{26} & D_{66} \end{bmatrix} \begin{bmatrix} \varepsilon_{x0} \\ \varepsilon_{y0} \\ \gamma_{xy0} \\ \varepsilon_{y} \\ \kappa_{x} \end{bmatrix} = \begin{bmatrix} N_{x} \\ N_{y} \\ N_{xy} \\ N_{xy} \\ M_{x} \end{bmatrix} + \begin{bmatrix} N_{xt} \\ N_{yt} \\ N_{xyt} \\ N_{xyt} \\ M_{xt} \end{bmatrix} \Delta T \quad (A.8)$$

where the composite material properties are determined by

$$A_{ij} = \sum_{k=1}^{N} (\bar{Q}_{ij})_{k} (z_{k} - z_{k-1})$$

$$B_{ij} = \frac{1}{2} \sum_{k=1}^{N} (\bar{Q}_{ij})_{k} (z_{k}^{2} - z_{k-1}^{2})$$

$$D_{ij} = \frac{1}{3} \sum_{k=1}^{N} (\bar{Q}_{ij})_{k} (z_{k}^{3} - z_{k-1}^{3})$$
(A.9)

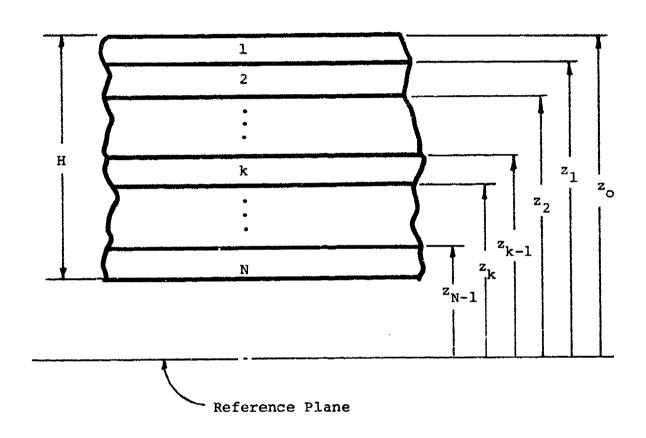


Figure A-3. Composite Laminate.

and the stress resultants due to thermal change are,

$$\begin{pmatrix}
\mathbf{N}_{\mathbf{xt}} \\
\mathbf{N}_{\mathbf{yt}} \\
\mathbf{N}_{\mathbf{xyt}}
\end{pmatrix} = \Delta \mathbf{T} \sum_{k=1}^{\mathbf{N}} \begin{bmatrix} \overline{Q}_{11} & \overline{Q}_{12} & \overline{Q}_{16} \\ \overline{Q}_{12} & \overline{Q}_{22} & \overline{Q}_{26} \\ \overline{Q}_{16} & \overline{Q}_{26} & \overline{Q}_{66} \end{bmatrix}_{k} \begin{pmatrix} \alpha_{\mathbf{x}} \\ \alpha_{\mathbf{y}} \\ \alpha_{\mathbf{xy}} \end{pmatrix}_{k} (\mathbf{z}_{k} - \mathbf{z}_{k-1})$$

$$\begin{pmatrix}
\mathbf{M}_{\mathbf{xt}} \\
\mathbf{M}_{\mathbf{yt}} \\
\mathbf{M}_{\mathbf{xyt}}
\end{pmatrix} = \frac{\Delta \mathbf{T}}{2} \sum_{k=1}^{\mathbf{N}} \begin{bmatrix} \overline{Q}_{11} & \overline{Q}_{12} & \overline{Q}_{16} \\ \overline{Q}_{12} & \overline{Q}_{22} & \overline{Q}_{26} \\ \overline{Q}_{16} & \overline{Q}_{26} & \overline{Q}_{66} \end{bmatrix} \begin{pmatrix} \alpha_{\mathbf{x}} \\ \alpha_{\mathbf{y}} \\ \alpha_{\mathbf{xy}} \end{pmatrix} (\mathbf{z}_{k}^{2} - \mathbf{z}_{k-1}^{2})$$

$$(A.10)$$

A.1.4 Strain and Stress in the Laminae

The strains (ε_{xo} , ε_{yo} , γ_{xyo}) and the curvatures (κ_{x} , κ_{y} , κ_{xy}) of the laminate reference surface are determined by solving the Equation A.8. The in-plane strains in the laminate at a distance 2 from the reference plane are then written as

$$\begin{cases}
\varepsilon_{x} \\
\varepsilon_{y} \\
\gamma_{xy}
\end{cases} = \begin{cases}
\varepsilon_{xo} \\
\varepsilon_{yo} \\
\gamma_{xyo}
\end{cases} + z \begin{cases}
\kappa_{x} \\
\kappa_{y} \\
\kappa_{xy}
\end{cases} \tag{A.11}$$

The stresses at position z are

$$\begin{pmatrix} \sigma_{\mathbf{x}} \\ \sigma_{\mathbf{y}} \\ \sigma_{\mathbf{x}\mathbf{y}} \end{pmatrix} = \begin{bmatrix} \overline{Q}_{11} & \overline{Q}_{12} & \overline{Q}_{16} \\ \overline{Q}_{12} & \overline{Q}_{22} & \overline{Q}_{26} \\ \overline{Q}_{16} & \overline{Q}_{26} & \overline{Q}_{66} \end{bmatrix} \begin{pmatrix} \varepsilon_{\mathbf{x}0} \\ \varepsilon_{\mathbf{y}0} \\ \gamma_{\mathbf{x}\mathbf{y}} \end{pmatrix} - \begin{pmatrix} \alpha_{\mathbf{x}} \\ \alpha_{\mathbf{y}} \\ \alpha_{\mathbf{x}\mathbf{y}} \end{pmatrix} \Delta \mathbf{T} + \mathbf{Z} \begin{pmatrix} \kappa_{\mathbf{x}} \\ \kappa_{\mathbf{y}} \\ \kappa_{\mathbf{x}\mathbf{y}} \end{pmatrix} \tag{A.12}$$

When Z lies within layer k, then the subscript k is presumed to be attached to the material properties in Equation A.12.

A.2 NORMAL INTERLAMINAR EDGE STRESSES

Consider a laminated composite tension specimen as shown in Figure A-4. Depending on the stacking sequence of the laminae which compose the laminate, the free edge indicated in the figure can undergo delamination failure before the laminate as a whole fails. The occurrence of this disturbing phenomenon led to the development of the theory presented in References 16-19 and summarized below.

The stress resultants in the specimen due to the applied load P in the x-direction are clearly

$$N_{x} = \frac{P}{2b}$$

$$N_{y} = N_{xy} = M_{x} = M_{y} = M_{xy} = 0$$
(A.13)

Then the strains and stresses in the various lamina are computed by solving Equation A.8, and evaluating Equations A.11 and A.12 for appropriate values of Z. In this case the lamina stresses are constant through the thickness of each layer.

Figure A-5 shows a section cut from the laminate; the section geometry is characterized by one unit in the x-direction, a symmetric half in the y-direction, and full thickness in the z direction. The forces acting on the laminate in the y-direction are also shown on the figure. Since the free edge is stress free, the forces acting at the y=0 must balance through the layers. Now consider layer number 1 which is isolated in Figure A-6. Clearly, since the edge y=b is stress free, there must be some area near the free edge which must develop an interlaminar shear force F_1 and moment M_1 to balance the force σ_{y1} h_1 acting at y=0. This line of reasoning can be extended to conclude that all layers must develop interlaminar edge forces and moments as shown in Figure A-7.

If the typical layer k is required to be in equilibrium with respect to force-sums and moment sums, the following equations result:

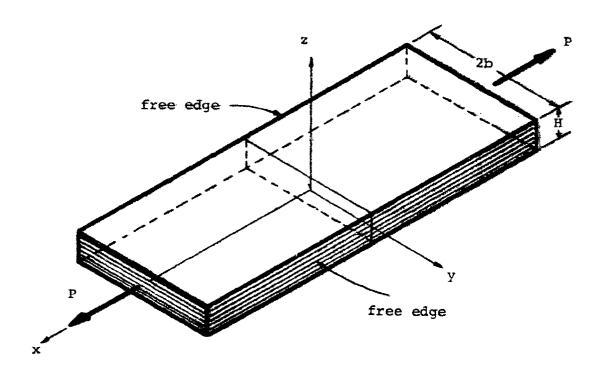


Figure A-4. Composite Tension Specimen.

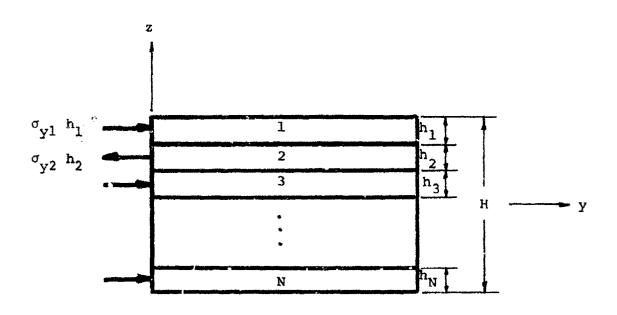


Figure A-5. Laminate Section at X = 0.

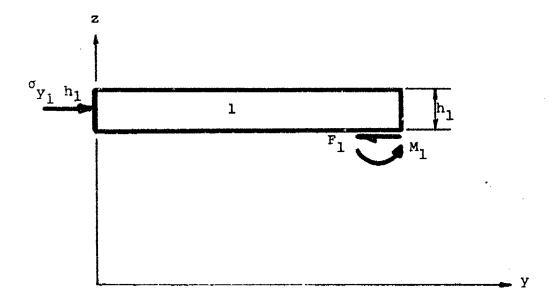


Figure A-6. Layer Number 1.

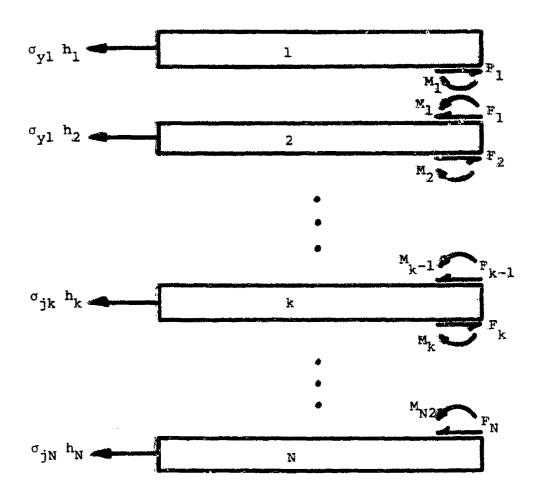


Figure A-7. Layer Edge Forces.

$$F_{k} = \sigma_{k} h_{k} + F_{k-1}$$

$$M_{k} = \frac{\sigma_{k} h_{k}^{2}}{2} + F_{k-1} \hat{h}_{k} + M_{k-1}$$
(A.14)

If these equations are applied sequentially starting with k=1, for which $F_0=M_0=0$, then each set of interlaminar forces can be determined in a recursive manner.

Now it is argued that the only way to develop edge moments near the free edge is to have a nonuniform distribution of interlaminar normal stress in that area. Such a normal stress is shown in Figure A-8, in which the distribution over a small length assures that the total moment of M_k, and the tension and compression areas balance. An approximate normal stress distribution (References 17-19) is shown in Figure A-9. Finally, using the approximate interlaminar normal stress distribution of Figure A-9, the following value is found for the normal stress at the free edge,

$$\sigma_{e\dot{k}} = \frac{90}{7} \frac{M_k}{H^2} \tag{A.15}$$

A.3 COMPUTATIONS FOR SPECIFIC LAMINATES

The analysis presented above has been utilized to estimate interlaminar normal stresses for seven specific laminates. The particular material systems and stacking sequences considered, along with their respective properties are listed in Table A-1.

The normal edge stresses developed in these composites are illustrated in Figure A-10. The five curves in the tensile half of the figure all have the same ply stacking sequence. The different tensile stress levels developed indicate the influence of material properties. The three curves for G-160/6535-1 graphite/epoxy illustrate the effects of different ply stacking sequences. Orientations (1) and (3) in Figure A-10

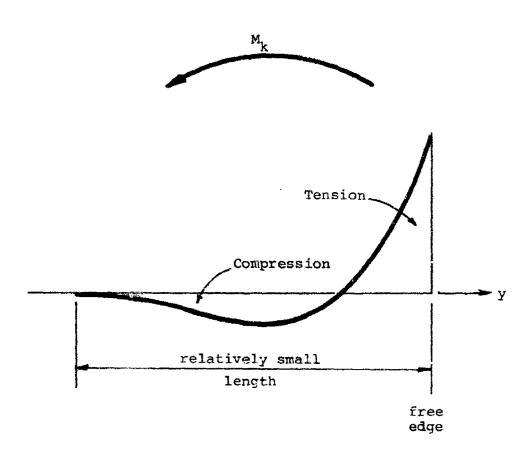


Figure A-8. Distribution of Normal Stress Near Free Edge.

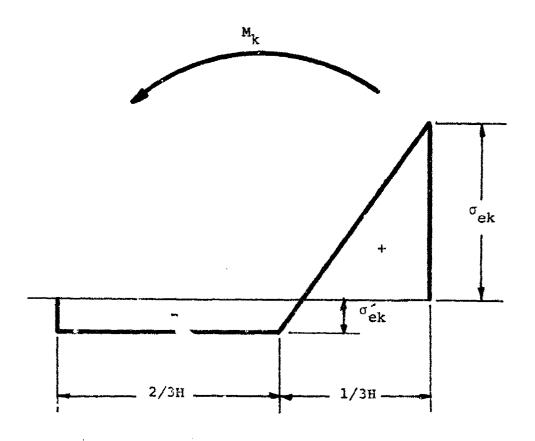


Figure A-9. Approximate Distribution of Interlaminar Normal Stress at Layer k.

TABLE A-1
LAMINATE SYSTEMS CONSIDERED IN SAMPLE INTERLAMINAR
NORMAL STRESS ANALYSIS

			<u></u>				
	HyE 2034D	HyE 1076J	sic/5506	T300/V378A	G-160/6535-1	G-160/6535-1	G-160/6535-1
tolv (inch)	0.0049	0.0051	0.0064	0.0051	0.0048	0.0048	0.0048
E1 (pst)	44.5 x 10 ⁶	20.0 x 10 ⁶	33.4 × 10 ⁶	20.0 x 106 33.4 x 106 20.1 x 106	18.5 x 10 ⁶	18.5 x 10 ⁶	18.5 × 10 ⁶
E2 (DS1)	0.87 × 10 ⁶	1.34 × 106	2,99 x 10 ⁶	1.34 x 106 2.99 x 106 1.31 x 106 1.82 x 106	1.82 x 106	1.82 × 10 ⁶	1.82 × 10 ⁶
Gra (pat)	0.73 x 10 ⁶	0.92 x 106	0.74 x 10 ⁶	0.92 x 106 0.74 x 106 1.62 x 106 0.95 x 106	0.95 x 10 ⁶	0.95 x 10 ⁶	0.95 x 10 ⁶
7-24 7TD	0.22	0.32	0.23	0.30	0.32	0.32	0.32
plv orientation	(1)	(1)	(1)	(1)	(1)	(2)	(3)

(1) (0,45,-45,0,0,-45,45,0,90,0) s

(2) (0,45,-45,0,0,-45,45,0)_s

(3) (0,90,45,-45,0,0,-45,45,0,0)_s

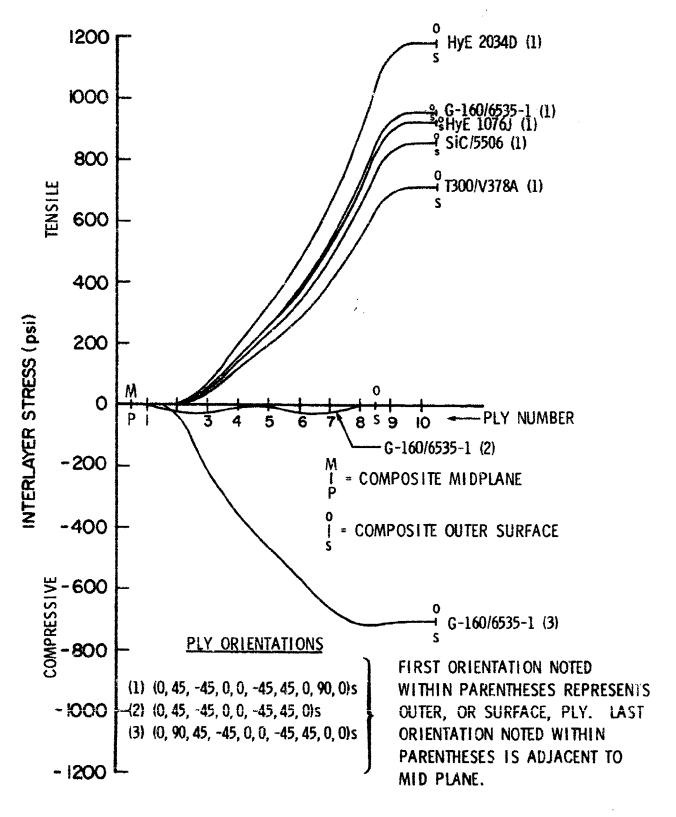


Figure A-10. Interlayer Normal Stresses for Various Composite Laminates.

differ only in the position of the 90° ply, while orientation (2) has no 90° ply and has one less 0° ply than orientations (1) and (3). All of the stresses plotted in Figure A-10 were computed for a stress resultant $N_{\rm X}$ = 1000 lb/in (1751 N/cm), as indicated in Equation (A.13).

APPENDIX B

PREPREG QUALITY CONTROL TEST PROCEDURES AND TEST RESULTS

This appendix contains copies of the test procedures followed in determining prepreg physical properties. It also presents the test results obtained from these various tests on each prepreg material. Summaries of these data are presented in Sections 4.1 through 4.6.

In addition to the tables of physical properties, chromatographic analyses are presented for resin extracted from each prepreg.

Hercules Specification Volatile Content

HD-SG-2-6006C

5.1.2 Test procedure. The test procedure shall be as follows:

- a. Condition new Gooch filtering crucibles in beaker containing concentrated HNO3 for a minimum of 1 hour at $100 \pm 5^{\circ}$ C. Wash with water, dry in oven at $93 \pm 3^{\circ}$ C and desiccate.
- b. Weigh conditioned filtering crucible to the nearest 0.1 milligram (mg).
- c. Carefully remove release paper from prepreg specimen and place specimen in tared crucible.
- d. Weigh crucible containing specimen to the nearest 0.1 mg.
- e. Condition crucible and specimen in an oven maintained at 93.5°

 ± 3° C for a minimum of 90 minutes and a maximum of 120 minutes,
 unless otherwise specified in the applicable prepreg specification.

NOTE

Prepregs with polyimide resin systems should be conditioned at $288 \pm 3^{\circ}$ C for 60 ± 1 minutes.

- f. Remova crucible from oven, cool to room temperature in a desiccator, and reweigh.
- g. Calculate volatiles content of prepreg as follows:

Weight % Volatiles =
$$\frac{W_2 - W_3}{W_2 - W_1} \times 100$$

where: W₁ = weight of empty conditioned filtering crucible, grams (g)

W₂ = original weight of crucible and specimen before heating, g

W3 = final weight of crucible and specimen after heating, g

Hercules Specification Resin Content

325-SC-1-6006C

5.2.3 Procedure C (hot NEK extraction method). Determine resin content of prepring by the hot NEK extraction method as follows:

a. Propreg samples shall be as specified in table I. Take duplicate tast specimens, one from each end of the sample.

Table I. Resin Content Specimens for Procedures C, D, and E

Tape width	Sample siza
3 inches	3 inches by 3 inches
6 inches	2 inches by 6 inches
12 inches	1 inch by 12 inches

- b. Weigh clean filtering crucible to the nearest 0.1 mg.
- c. Carefully remove release paper from the prepreg specimens and place in taxed crucible.
- d. Weigh crucible containing specimen to the nearest G.1 mg.
- e. Add 150 ml MER to a 250 ml basker, place beaker on a steam bath and bring to a boil. (Beaker should be covered with a watch glass to minimize evaporation.)
- f. Add prepret sample to the bot MEK, being careful not to splash the bot MEK. Stir occasionally and let heat for ten minutes or until MEK boils.
- g. Transfer the MEK and fiber into the original tered filtering crucible positioned in a filtering flask with vacuum trap and vacuum pump.
- h. Wash the fiber three times with additional hot MEK.
- Remove the crucible containing fibers and dry in an oven maintained at 163° ± 3° C for 15 to 20 minutes.
- j. Remove crucible from oven, cool in a desiccator, and weigh to the nearest 0.1 mg.
- k. Calculate rasin content as follows:

Weight 7 Resin =
$$\begin{bmatrix} W_2 - W_3 \\ \overline{W_2 - W_1} \\ \end{bmatrix} \times 100$$
 - V

where: W, - weight of empty crucible, g

W2 - original weight of crucible and specimen, g

Wg = final weight of crucible and fibers, g

V - weight percent volatiles from 5.1, %

Hercules Specification Resin Flow

ED-SG-2-6006C

5.3.2 Procedure B. Determine resin flow as follows:

- a. Cut eight 4 x 4 inch plies of sample prepreg.
- b. Lay up the prepreg plies $0^{\circ}/90^{\circ}$ and weigh to the nearest 0.1 g.
- c. Place layup on 1/4 inch thick aluminum plate which has been covered with nonporous teflon.
- d. Cut one 6 x 6 inch ply of porous TFE release cloth and place on top of layup.
- e. Cut two 6 x 6 inch plies of glass bleeder cloth and place on top of TFE release cloth.
- f. Cover entire layup with 1 ply of glass bleeder cloth to be used as air breather.
- 8. Place entire assembly in vacuum bag.
- h. Place in oven at room temperature and pull full vacuum (25 inches Hg).
- Bring oven up to 250°F (oven temperature) in 30 to 45 minutes and hold at 250°F for 30 minutes while maintaining full vacuum.
- j. Raise temperature to 350°F (oven temperature) in 30 to 45 minutes and hold at 350°F for 60 minutes.
- k. Remove from oven while hot and remove from vacuum bag.
- 1. Clean any excess resin from panel.
- m. Weigh panel to the nearest 0.1 g.
- n. Calculate the resin flow as follows:

Resin flow, percent =
$$\frac{W_1 - W_2}{W_1} \times 100$$

where: W₁ = original weight of prepreg layup, g.

 W_2 = final weight of panel, g.

c. Report the average of a minimum of two determinations.

Hercules Specification Gel Time

BD-5G-2-60060

- 5.5 Gal time. The prepreg gel time shall be determined as follows:
- 5.5.1 Specimen preparation. Prepare specimen for gal time test as follows:
 - cut 12 to 13 prepring strips 3/4-inch by 3-inch (4 to 5 grams) and stack strips on top of each other. Roll stacked prepring strips to form an approximately 3/4-inch by 3/4-inch dismeter cylinder as shown in figure 2.
 - b. Place prepared specimen on one end of approximately 3-1/2 inch by 7-inch x 0.006 inch aluminum foil and roll tightly. Fold open ends tightly over the middle and cut one corner with scissors to make approximately 1/16 inch opening. (See figure 3.)
- 5.5.2 Equipment preparation. Prepare equipment for gel time testing as follows:

- a. Place bottom gel plate (figure 4) 1/4-inch from front center of bottom press platen and tape down, with three-inch wide green pressure sensitive tape.
- b. Flace top gel plate (figure 4) against top press platen and center directly over bottom gel plate as shown in figures 5 and 6. Tape top gel plate in place with green pressure sensitive tape.
- c. Place a thermocouple on the center of bottom gel plate, 3/4-inch from the front end and as shown in figure 3. Stabilize at test temperature specified in the applicable prepreg specification.
- 5.5.3 Test procedure. The gel time test procedure shall be as follows:
 - a. Place thermocouple on bottom gel plate, 3/4-inch in from the front edge of the plate and 1-1/2 inches from either left or right edge as shown in figure 5. Use green pressure sensitive tape to secure the thermocouple wire so that the thermocouple will remain in the intended position.
 - b. Place gel specimen on bottom gel place so that the cut corner is positioned 1/8 to 1/4 inch behind thermocouple and facing the operator.
 - c. Close the press placen quickly and apply sufficient pressure to obtain approximately 1/4 inch resin bead. Start timing at this point. The total elapsed time from the time specimen is placed on gel plate to closing placens should be 15 ± 5 seconds.
 - d. Using a wooden probe, probe the edges of the resin bead. As gal time approaches, the resin becomes quite viscous and forms a string as the wooden probe is moved away from the resin. Continua probing until the resin cases to string and the resin mass becomes no longer plastic. At this point the resin mass should form permanent deformation when pressed with the tip of the wooden probe. Note the alapsed time and record the time and the test temperature.
 - e. Report the average of a minimum of two determinations.

ADVANCED COMPOSITE DESIGN GUIDE (VOL. IV) SPECIFICATIONS FOR PREPREG RESIN AND VOLATILE CONTENT

JANUARY 1973

4. 2. 3. 2 RESIN CONTENT

4. 2. 3. 2. 1 Graphite

One 2-inch-square specimen with volatiles removed is placed in a 150 to 250 ml beaker. The beaker is filled with 100 ml of nitric acid (HNO3) and placed on a hot plate maintained at 100° C ±5° C (212° F). The sample is digested until fiber is completely separated as determined by visual examination. The acid and fibers are transferred into a tared glass filtering crucible positioned in a filtering flash with vacuum trap and vacuum pump. Fibers are washed three times with 20 ml of HNO3 and followed by water wash.

The crucible and fibers are dried at 93.5° C ±3° C (200° F) for a minimum of 60 minutes, cooled in a desiccator, and the weight (W4) is obtained. The weight percent of resin is computed from:

Resin content w/o =
$$\frac{W_3 - W_4}{W_2 - W_1}$$
 (100)

where

W₁ = is crucible weight

W2 = is sample and crucible weight

W₃ = is specimen weight

W4 = is weight after acid digest (fibers)

Compute weight percent of fiber from:

Fiber content w/o =
$$\frac{W_4 - W_1}{W_2 - W_1}$$
 (100)

4.2.3.3 VOLATILE CONTENT

The following procedure is applicable to both graphite and boron prepreg. Filtering crucibles are conditioned in a beaker containing concentrated nitric acid (HNO₃) for a minimum of 1 hour at 100° C ±5° C (212° F). The crucible is washed, desiccated, and weighed (W₁). A 2-inch-square prepreg sample is placed in the crucible and weighed (W₂). Prepregs with epoxy resin systems are conditioned in a nonrecirculating oven maintained at 93.5° C ±3° C (200° F) for a minimum of 90 minutes and a maximum of 120 minutes. The crucible is removed from the oven, desiccated, and reweighed (W₃). The weight percent of volatiles is obtained from

Volatiles w/o =
$$\frac{W_2 - W_3}{W_2 - W_1}$$
 (100)

Data are averaged from a minimum of three tests.

QUALITY CONTROL METHOD QCI-C-V-14

Fiberite Specification

VOLATILE CONTENT OF GRAPHITE PREPREG

- 1. Place a 2" x 2" sample into previously weighed Aluminum pan (W_2) . Sample must lay flat and cannot be rolled up or more than one ply thick.
- 2. Weigh sample and pan to the nearest milligram (W,).
- 3. Place into a forced air oven maintained at 163±3°C for 20±0.5 minutes.
- 4. Cool to room temperature in a desiccator and weigh to the nearest milligram (W_3).
- 5. Calculate as follows:

Volatile content, percent
$$=\frac{W_1 - W_3}{W_1 - W_2} \times 100$$

W, = weight of pan plus specimen before volatile removal.

 W_2 = weight of pan.

 W_3 = weight of pan plus specimen after volatile removal.

QUALITY CONTROL METHOD R-15

Fiberite Specification

RESIN SOLIDS CONTENT OF GRAPHITE PREPREG

SCOPE: This method is applicable for the determination of percent resin solids in unfilled carbon or graphite prepreg roving or tape material where this method has been found suitable or is called out in a specification.

PROCEDURE: 1. Run volatile content on a sample cut adjacent to the sample to be used for resin solids. The volatile procedure used shall be as specified in the material specification.

- 2. Cut a sample of material approximately 3 grams in any convenient size.
- 3. Weigh the sample to the nearest 0.0001 gram. Record this as W₁
- 4. Place the sample in a 400 ml beaker. Add 200 ml of DMF (Dimethyl formamide). Boil for 5 minutes (time starts when the DMF starts to boil).
- 5. Cool sample. Pour off the DMF. Wash sample twice with acetone.
- 6. Place sample in a tared aluminum foil pan. Dry sample for 30 minutes in an oven maintained at 163±3°C.
- 7. Cool sample to ambient temperature in a desiccator.
- 8. Reweigh the sample to the nearest 0.0001 gram. Record the weight as $W_{\,2}$.

CALCULATION: Resin Solids (% by weight) =

$$\frac{(W_1 - W_1 \ V) - W_2}{(W_1 - W_1 \ V)} \times 100$$

Where: $W_1 = Original sample weight.$

 W_2 = Weight of carrier remaining after extraction.

V = Percent volatiles (Procedure as called out by the material specification).

QUALITY CONTROL METHOD QCI-C-F-42

Fiberite Specification

FLOW OF GRAPHITE PREPREG

Flow:

Laminate

Form:

2 ply 2" x 2" square cut

Lay-up:

Cut 6 pieces of style 1581 glass bleeder cloth, 4" x 4" square and 2 pieces of pourous teflon separator cloth (EMFAB TX-1040 or equivalent) 4" x 4" square. Weigh all to the nearest milligram (W 1). Cut 2 pieces of prepreg 2" x 2", cross ply 0 and 90 , and assemble as follows: 3 pieces 1581 glass, 1 piece porous teflon, 2 pieces graphite prepreg (cross plied 0° and 90°), I piece porous teflon, 3 pieces 1581 glass, and weigh to the nearest milligram (W,).

Temperature:

325 - 5 F

Pressure:

100 psi (400# total pressure)

Time:

15 - 1 minute

Determination:

As required

Procedure:

Put Mylar release film on both sides of Lay-up and place into 325 F preheated press. Apply 100 psi for 15 minutes. Remove and discard Mylar film. Remove crossplied test specimen and weigh 1581 glass

and porous teflon to nearest milligram (W 3).

Calculation:

Flow, $\% = \frac{W_3 - W_1}{W_2 - W_1} \times 100$

 W_1 = Weight of 1581 glass fabric and porous teflon separator

 W_2 = Weight of 1581 glass fabric, porous teflon separator and cross plied specimen.

W₃ = Weight of 1581 glass fabric and porous teflon separator after cure.

QUALITY CONTROL METHOD G-2

Fiberite Specification

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GEL TIME

Gel time of graphite prepreg tape or broadgoods materials.

SCOPE: This method is applicable for the determination of gel time on carbon or graphite prepring materials containing a thermosetting resin which undergoes gelation at a specified temperature.

APPARATUS

- 1. Fisher-Johns melting point apparatus
- 2. Thickness No. 2 cover glasses (18 mm)
- 3. Timer or stopwatch
- 4. Wooden picks

PROCEDURE

- 1. Preset the Fisher-Johns melting point apparatus to read = 1. C of the specified temperature.
- 2. Insert a $\frac{1}{4}$ " x $\frac{1}{4}$ " sample between 2 cover glasses and place on the Fisher-Johns apparatus.
- 3. Start the timer and probe the specimen with a wooden pick.
- 4. When resin gels (this is usually evident when no resin movement is seen when moderate pressure is applied to the specimen) stop the timer and report the gei time to the nearest 0.1 minute
- 5. Report the gel time as the average of three determinations.

GEL TEMPERATURES FOR GRAPHITE PREPREG

RESIN SUFFIX	TEST TEMPERATURE (°C)	
-48	121	
-30	170 C	
-34	163°C (32 F)	

Example

hy-E 1348-B Run at 121 C

	PREPREG	PHYSICAL PRO	OPERTIES .	
Material:	T300/AFR800		Vendor: Her	kcel
Lot/Batch Number	Spool/Roll Number	Volatile Content (% by wt)	Resin Content (% by wt)	Resin Flow (% by wt)
22300	1	0.26	41.95	14.91
22300	1	0.32	41.43	12.59
22300	1	0.32	42.99	14.19
Lot/Batch Number	Spool/Roll Number	Gel Time @ 275°F(135°Q) (minutes)		
22300	1	141		
22300	1	142		
22300	1	141		
	Received:	Tested:	Renarks	
Spool #1	11-20-78	11-21-78	Volatiles, Resi	in Content,Flo
		12-18-78	Gel Time	

Test Procedures Followed			
Property	Applicable Test Spec.	Source of Test Spec.	
Volatile Content	HD-SG-2-6006C (5.1.2)	Hercules	
Resin Content	HD-SG-2-6006C (5.2.3C)	Hercules	
Resin Flow	HD-SG-2-6006C (5.3.2B)	Hercules	
Gel Time	HD-SG-2-6006C (5.5)	Hercules	

PREPREG PHYSICAL PROPERTIES				
Material:	T300/AFR800		Vendor: Hex	cel
Lot/Batch Number	Spool/Roll Number	Volatile Content (% by wt)	Resin Content (% by wt)	Resin Flow (% by wt)
22300	2	0.18	41.54	15.49
22300	2	0.07	39.73	15.52
22300	2	0.07	39.11	15.53
Lot/Batch Number	Spool/Roll Number	Gel Time @ 275°F(135°C) (minutes)		
22300	2	140		
22300	2	139		
22300	2	141		
	Received:	Tested:	Rema	rks
Spool #2	11-30-78	12-1-78	Volatiles, Resi	n Cont.,Flow
		1.2-13-78	Gel Time	

Test Procedures Followed			
Property	Applicable Test Spec.	Source of Test Spec.	
Volatile Content	HD-SG-2-6006C (5.1.2)	Hercules	
Resin Content	HD-SG-2-6006C (5.2.3C) Hercules		
Resin Flow	HD-SG-2-6006C (5.3.2B) Hercules		
Gel Time	HD-SG-2-6006C (5.5)	Hercules	

Material:	T300/AFR800		Vendor: Hex	cel
Lot/Batch Number	Spool/Roll Number	Test Date	Gel Time (minutes)	Resin Flow (% by wt)
22300	1	1-3-79		21.7
22300	1	1-8-79	152	
22300	2	1-4-79		19.3
22300	2	1-10-79	140	
22300	2	1-19-79		21.9

(1) These tests were conducted to determine the effect of room temperature storage on prepreg properties.

Month	Procedures	Fallowed
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	MALCHARITATION CONTRACTOR	rai:awaa

Property	Applicable Test Spec.	Source of Test Spec.
Volatile Content		
Resin Content		
Resin Flow	HD-SG-2-6006C(5.3.2B)	Hercules
Gel Time	HD-SG-2-6006C (5.5)	Hercules

	PREPREG	PHYSICAL PRO	OPERTIES .	
Material:	SiC/5506		Vendor: A	7CO
Lot/Batch Number	Spool/Roll Number	Volatile Content (% by wt)	Resin Content (% by wt)	Resin Flow (% by wt)
2	1	1.28	29.18	dea sum sude
2	1	1.38	28.20	
2	1	1.49	27.25	
2	4		26.68	
2	4	1.48	27.13	
2	4	1.56	28.28	
2	2B	1.32	26.86	
2	2B	1.27	26.95	
2	2B	1.42	28.48	
2	2A	1.28	28.49	
2	2A	1.42	28.84	
2	2A		28.37	

Test	Procedures	Followed

Property	Applicable Test Spec.	Source of Test Spec.
Volatile Content	Section 4.2.3.3	Advanced Composites Design Guide,
Resin Content	Section 4.2.3.2.1	Jan. 1973, Vol. IV
Resin Flow		

HPLC ANALYSIS

SAMPLE (CONC.) AVCO 5 MOBILE PHASE 1 ACETOM FLOW RATE 2.6 1/4: COLUMNIS 095 ATTENUATION 32 CHART SPEED 0.5 1 DATE NOVEMBER 23	PROGRAM M DETECTOR TR WAVE LENGTH FULL SCALE (m)	2 WATER ETH : 0 ACOR 970 230 nm 20mV	
TIME O TO MIN 21 MIN	WATER 76% 18%	ALETO.	24% 82% 99%

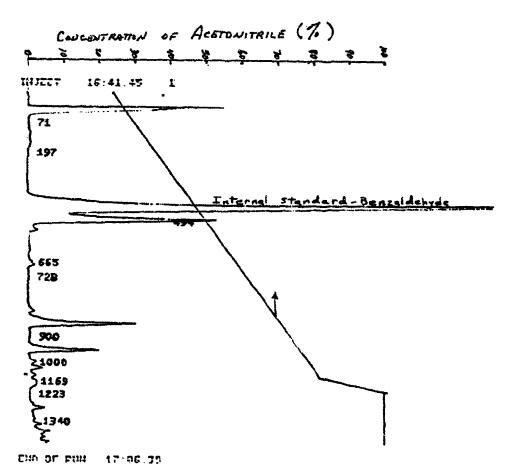


Figure B-1. HPLC Analysis of AVCO 5506 Epoxy Resin.

PREPREG PHYSICAL PROPERTIES							
Material:	HyE 2034D		Vendor: Fib	erite			
Lot/Batch Number	Spool/Roll Number	Volatile Content (% by wt)	Resin Content (% by wt)	Resin Flow (% by wt)			
C0-010	1	0.62	39.05	22.35			
		0.69	38.33	26.68			
		0.69	40.16	26.35			
Lot/Batch Number	Spool/Roll Number	Gel Time @ 325°F(163°C) (minutes)					
C0-010	11	12.63					
		12.48					
		12.23					

Test Procedures Followed								
Property	Applicable Test Spec.	Source of Test Spec.						
Volatile Content	QCI-C-V-14	Fiberite						
Resin Content	R-15	Fiberite						
Resin Flow	QCI-C-F-42	Fiberite						
Gel Time	G-2	Fiberite						

HPLC ANALYSIS

SAMPLE (CONC.) HYE- 2030 SAMPLE SIZE 1.5 29/201

MOBILE PHASE 1 Acctomitis Mobile Phase 2 Water

FLOW RATE 2.0 1 PROGRAM MARKED G

COLUMNIS) 009 DETECTOR Tracer 970

ATTENUATION 32 WAVE LENGTH 930 mm

CHART SPEED 0.5 1 PROGRAM FULL SCALE (MV) 10 mV

DATE NOVYM 510 20 71 OPERATOR WOLCE

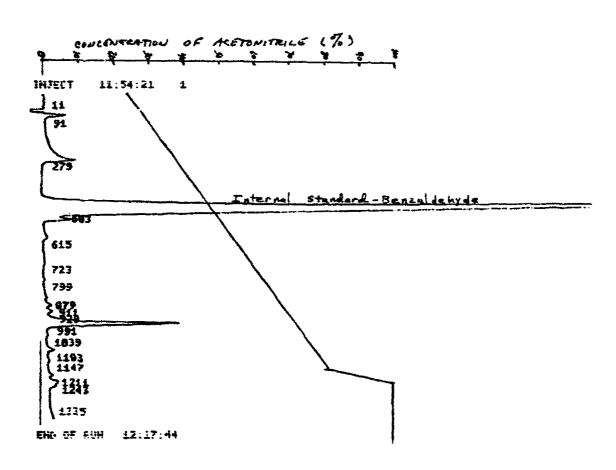


Figure B-2. HPLC Analysis of Fiberite 934 Epoxy Resin.

PREPREG PHYSICAL PROPERTIES								
Material: T300/V378A Vendor: U.S. Polymeric								
Lot/Batch Number	Spool/Roll Number	Volatile Content (% by wt)	Resin Content (% by wt)	Gel Time @ 210°F(99°C) (minutes)				
2W4810	1	5.79	29.00	30.52				
		6.05	30.28	32.03				
		4.61	32.63	31,97				
2W4683	1	2.51	31.31					

¹All data on Batch No. 2W4683 was generated by USP.

Test Procedures Followed

ce of Test Spec.			
Source of Test Spec			
iberite			
iberite			
iberite			
•			

²Test conducted at 350°F (177°C) for 5 minutes rather than 325°F (163°C) for 20 minutes as called for in step 3 of specification.

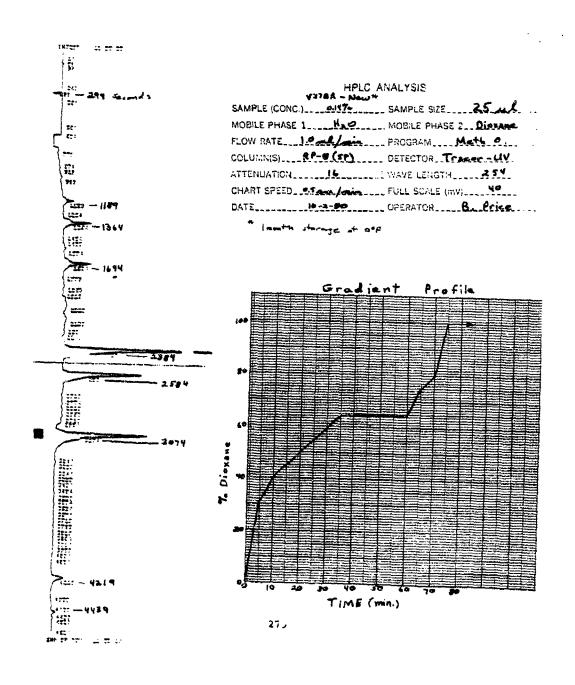


Figure B-3. HPLC Analysis of New U.S. Polymeric V378A Polyimide Resin.

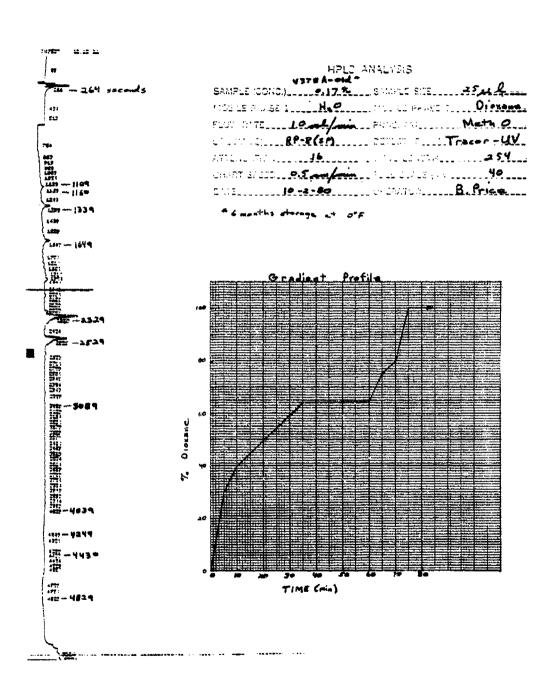


Figure B-4. HPLC Analysis of Old U.S. Polymeric V378A Polyimide Resin.

	PREPREG PHYSICAL PROPERTIES							
Material: HyE 1076J Vendor: Fiberite								
Lot/Batch Number	Spool/Roll Number	Resin Content (% by wt)	Gel Time ¹ (min)					
C1-285	1	0.57	37.77	21.4				
C1-285	1	0.51	37.84	20.1				
C1-285	1	0.23	37.46	22.3				

¹at 177°C

Test Procedures Followed

Property	Applicable Test Spec.	Source of Test Spec.			
Volatile Content	QCI-C-V-14	Fiberite			
Resin Content	Method-R-15	Fiberite			
Gel Time	Method-G-2	Fiberite			

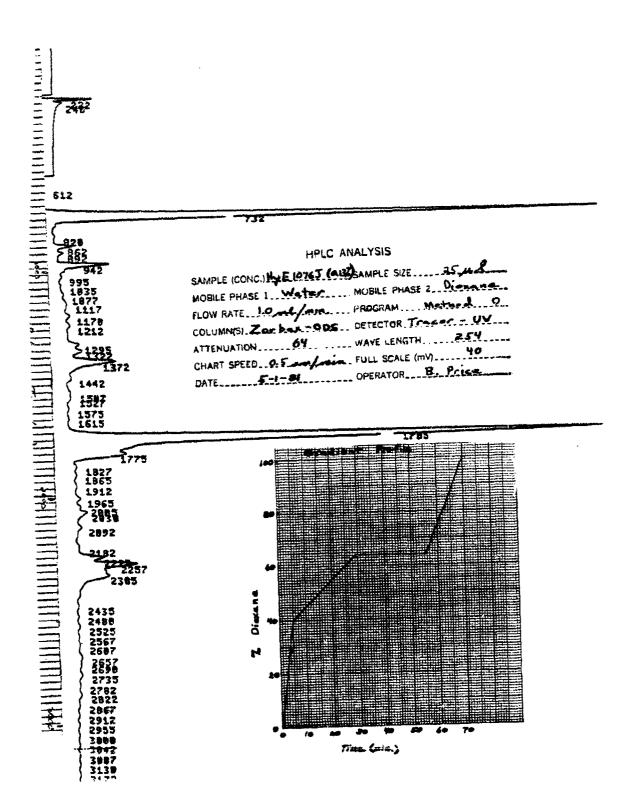


Figure B-5. HPLC Analysis of Fiberite 976 Epoxy Resin.

PREPREG PHYSICAL PROPERTIES							
Material:	G-160/6535-1		Vendor: AVCO				
Lot/Batch Number	Spool/Roll Number	Volatile Content (% by wt)	Resin Content (% by wt)	Gel Time @ 327°F(164°C (minutes)			
	440	0.23	39.27	38.49			
		0.22	41.58	37.21			
		0.14	40.82	38.55			
	441	0.28	42.77	38.68			
		0.13	40.73	37.75			
		0.22	44.09	38.30			

Test Procedures Followed

Property	Applicable Test Spec.	Source of Test Spec.			
Volatile Content	QCI-C-V-14	Fiberite			
Resin Content	R-15	Fiberite			
Gel Time	G-2	Fiberite			

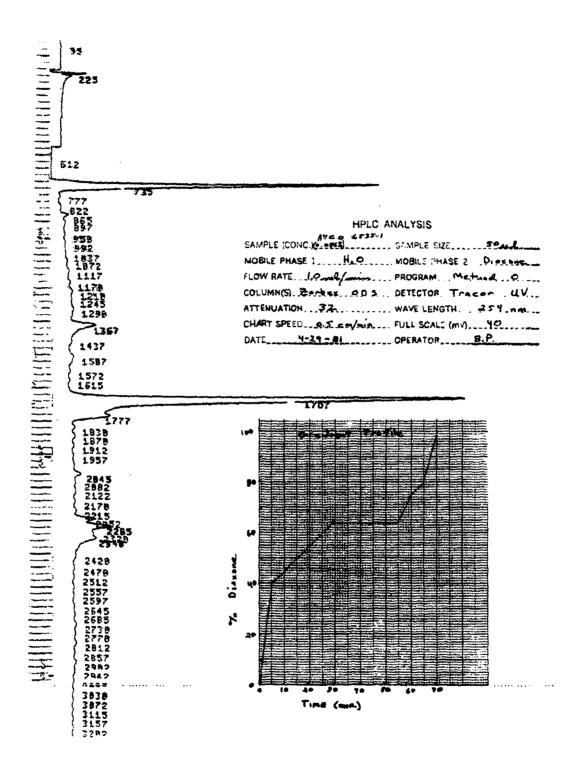


Figure B-6. HPLC Analysis of AVCO 6535-1 Epoxy Resin.

APPENDIX C LAMINATE PHYSICAL PROPERTY DATA

All of the physical property measurements conducted upon the panels fabricated and used in this program are presented here. Summaries of these data appear in Sections 4.1 through 4.6. 極ない間でははないのであるとうというというできないというながられていることははないとうないできょうとなっている

LAMINATE PHYSICAL PROPERTIES Material: T300/AFR800 Prepreg Fiber Resin Void Thick. Lot/ Prepreg Fiber Content Content Content Spool/Roll Lam. No. Spec. per_ply Batch % by wt) (% by vol(% by vol(10-3in.) No. Orient. Plies Grav. No. No. 00 0.0 22300 Fl 6 1.60 24.4 71.2 1 OO: 72.0 22300 1 F3 1.64 25.4 0.0 6 00 70.4 25.2 F4 6 1.60 0.0 22300 1 00 25.3 72.5 0.0 22300 1 F5 6 1.65 00 22300 F6 1.58 31.8 63.4 0.0 1 6 00 15 1.59 24.4 22300 1 F7 70.7 0.0 00 71.4 15 1.62 25.0 0.0 22300 1 F8 00 F9 15 1.61 25.4 70.7 0.0 22300 1 900 22300 1 Fll 15 1.60 25.0 70.6 0.0 900 25.3 0.0 22300 ī F12 15 68.6 1.56 900 F13 15 1.62 24.9 71.5 0.0 22300 1 90° 24.2 72.2 22300 1 F14 15 1.62 0.0 900 24.5 72.0 22300 F15 15 1.62 0.0 1 900 1.54 22300 1 F16 15 24.6 1.1 68.3 90⁰ 1 24.3 22300 F17 15 1.61 0.0 71.7 900 F18 15 1.62 24.1 0.0 22300 1 72.2 00 24.1 22300 1 F19 14 1.67 0.0 73.9 900 F20 14 1.71 23.5 0.0 22300 1 77.0 oō F21 15 1.62 24.0 72.5 2.5 22300 1 ٥ô F22 6 1.58 25.9 68.8 0.0 22300 1 ±450 30.7 F23 8 1.57 64.0 0.0 22300 1 +45° F24 8 1.54 31.1 62.4 0.0 22300 1 ±450 F25 29.9 8 1.60 66.1 0.0 22300 1 ±450 F26 8 1.56 30.8 63.4 0.0 22300 1 ±45° F27 8 1.57 0.0 22300 30.1 64.5 1

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LAMINATE PHYSICAL PROPERTIES Material: T300/AFR800 Prepred Void Resin Fiber Thick. Lot/ Prepreg Content | per ply | Content Content Batch Spool/Roll Fiber No. Lam. Spec. (% by wt) (% by vol(% by vol)(10-3in.) No. Drient Plies Grav. No. No. ±45° 4.4 22300 1 F28 8 1.59 31.7 63.8 ±450 1 0.0 22300 33.1 61.1 F29 8 1.55 ±45° ī 31.4 0.0 22300 1.58 F30 8 63.7 450 ī 22300 1.58 25.9 68.9 0.0 8 F31 +45° 22300 ī 0.0 1.60 26.4 8 F32 69.3 +45° ī 0.0 22300 1.61 26.3 F33 8 69.8 90⁰ 22300 1 0.0 15 1.60 26.0 F34 70.4 90⁰ 22300 ī 0.0 20 1.60 F35 25.1 70.5 00 22300 0.0 20 1.61 F36 24.4 71.6 00 25.8 69.4 0.0 22300 1 F37 50 1.59 +₄₅0 1 1.59 27.6 0.0 22300 F33 50 67.2 26.6 0.2 1.60 69.1 Avg. ±0.04 ±2.8 ±0.8 3.7 Std. Dev.

LAMINATE PHYSICAL PROPERTIES

Material: SiC/5506

		0	- 5500						
Lam. No.	Fiber Orient		Spec. Grav.	Resin Content (% by wt)	Fiber Content (% by vol	Void Content (% by Vol	Thick.		Prepreg Spool/Roll No.
G9	900	15	2.37	19.2	59.5	0		2	1
G10	0 _©	40	2.36	17.9	59.5	1.70		2	1
G14	±45°	8	2.33	19.4	57.5	1.52		2B	2
G15	±45°	8	2.34	19.1	58.1	1.27		2B	2
G16	+ ₄₅ °	8	2.30	22.0	53.9	0		2B	2
G17	+ ₄₅ °	8	2.35	20.3	57.5	0		2B	2
G20	00	14	2.34	20.6	57.3	0		2B	2
G21	90 ⁰	14	2.40	18.2	60.4	0.02		2B	2
G22	900	15	2.37	19.6	58.6	0		2B	2
G23	00	6	2.39	13.4	60.0	0		2B	2
G24	900	15	2.38	20.3	58.3	0		2B	2
G25	90 [©]	1 5	2.38	18.8	59.4	0		2B	2
G26	900	15	2.38	17.5	60.4	1.87		2в	2
G27	±45°	8	2.36	19.4	58.4	0.12		2A	2A
G28	+ ₄₅ 0	8	2.34	19.1	58.1	1.41		2A	2A
G29	±45°	8	2,34	19.5	57.9	0.66		2A	2A
G30	+45°	8	2.33	19.3	57.6	1.41		2A	2A
G31	±450	8	2.32	19.0	57.7	2.24		2A	2A
G32	(1)	20	2.35	19.4	58.3	1.01		2A	2A
G33	(1)	20	2.36	18.6	59.0	1.17		2A	2A
G34	(1)	20	2.35	19.0	58.6	0.85		2A	2A
G35	(1)	20	2.35	18.7	58.4	1.26		2A	2A
G36	(1)	20	2.36	18.8	58.7	0.89		2A	2A
G37	00	14	2.41	17,4	61.2	0.46		2A	2A
G38	00	15	2.39	18.3	60.1	0		2A	2A
G39	(1)	20	2.35	18.7	58.8	1.19		2A	2A
G40	(1)	20	2.35	19.4	58.2	0.36		2A	4

(1) (0.45, -45, 0.0, -45, 45, 0.90, 0) s-20 ply.

TAMINATOR	DESVETORT	PROPERTIES
LAMILNALL	PHISTOAL	PROPERTIES

	rial:		/5506	·					
.am. No.	Fiber Orient		Spec. Grav.	Resin Content (% by wt)	Fiber Content (% by vol	Void Content (% by Vol	Thick. per ply	Prepreg Lot/ Batch No.	Prepreg Spool/Roll No.
G41	(1)	20	2.36	18.6	59.0	1.02		2A	4
G42	90°	16	2,38	18.5	60.0	0.11		2A	4
G43	(1)	20	2.36	18.6	58.9	1.15		2 A	4
G44	(1)	20	2,36	18.9	58.8	0.64		2 A	4
Avg.			2.36	19.0	58.6	0.7			
Std.	ev.		0.02	0.9	1.3	0.7			
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							·		
							· 		
. <u> </u>									

⁽¹⁾ $(0,45,-45,0,0,-45,45,0,90,0)_{s}$ -20 ply.

LAMINATE PHYSICAL PROPERTIES

Material: HyE 2034D

Lam.	Fiber Orient		Spec. Grav.	Resin Content (% by wt)	Fiber Content (% by vol	Void Content (% by vol	Thick. per ply	Prepreg Lot/ Batch No.	Prepreg Spool/Roll No.
Hl	0°	6	1.82	23.0	76.1	0.00		CO-010	1
H2	0°	6	1.81	23.0	69.8	0.00			
н3	90°	15	1.81	23.3	69.4	0.00			
н4	900	15	1,80	23.5	69.0	0.00			
Н6	90°	15	1.81	23.7	69.1	0.00			
H7	90°	15	1.78	26.3	65.6	0.00			
н8	0°	14	1.82	23.4	69.8	0.00			
Н9	90°	14	1.79	24.4	67.7	0.00			
н10	±45°	8	1.81	24.9	68.0	0.00			
H11			1.80	25.1	67.5	0.00			
н12			1.82	25.1	68.2	0.00			
н13			1.80	25.4	67.1	0.00			
н14			1.79	24.9	67.3	0.00			
н15			1.80	23.2	69.1	0.00			
н16			1.80	26.1	66. 5	0.00			
н17			1.80	25.9	66.8	0.00			
н18			1.82	24.6	68.6	0.00			
н19	*	•	1.81	23.2	69.5	0.00			
H20	(1)	20	1.81	23.7	68.9	0.00			
H21			1.81	23.9	68.9	0.00			
H22			1.81	24.9	67.6	0.00			
н23			1.81	24.2	68.6	0.00			
H24			1.80	25.1	67.6	0.00			
н25			1.80	24.1	68.4	0.00			
н26			1.79	24.4	67.6	0.00			
H27	1		1.80	25.1	62.9	0.00			

⁽¹⁾ $(0.45,-45.0.0,-45.45.0.90.0)_s$ - 20 ply.

:			LA	MINATE P	HYSICAL	PROPERT	IES		
Mate	rial:	НУЕ	2034D						
Lam. No.	Piber Orient		Spec. Grav.	Resin Content (% by wt)	Fiber Content (% by vol	Void Content (% by vol	Thick.	Prepreg Lot/ Batch No.	Prepreg Spool/Roll No.
H28	(1)	20	1.80	24.8	68.4	0.00		C0-010	1
н29	90°	20	1.81	23.9	68.8	0.00			
н30	0°	20	1.81	23.4	69.4	0.00			
H31	0°	15	1.81	25.0	68.1	0.00			
н32	0.	40	1.79	25.9	66.4	0.00			
н33	±45°	40	1.81	23.9	68.7	0.00			
н34	±45°	40	1.78	27.0	65.1	0.00			
н35	90°	15	1.80	25.1	68.8	0.00			
н36	90°	15	1.80	24.5	67.9	0.00		•	
Avg.			1.80	24.5	68.0	0			
Std.De	v.		0.01	1.0	1.5				

⁽¹⁾ $(0,45,-45,0,0,-45,45,0,90,0)_{s}$ - 20 ply.

LAMINATE PHYSICAL PROPERTIES

Material: T300/V378A

I-1 I-2 I-3 I-4 I-5 I-6	90° 90° ±45° ±45° ±45° ±45° ±45°	14 14 8 8 8 8	1.56 1.59 1.58 1.59 1.61 1.58	23.5 22.0 23.7 29.8 24.6	68.1 70.7 68.9 63.7 69.4	3.17 1.53 1.92 0.86		2W4683 2W4683 2W4683	1 1
I-3 I-4 I-5	90° ±45° ±45° ±45° ±45°	8 8 8 8	1.58 1.59 1.61	23.7 29.8 24.6	68.9 63.7	1.92 0.86		2W4683	1.
I-4 I-5	±45° ±45° ±45° ±45°	8 8 8	1.59	29.8 24.6	63.7	0.86			
I-5	±45° ±45° ±45°	8 8	1.61	24.6				2W4683	
	±45° ±45°	8		 	69.4	-0.54	L		1
I-6	±45°		1.58			-0.54		2W4683	1
	 	8		26.8	66.1	0.58		2W4683	1
1-?	+450		1.61	27.9	66.3	-1.70		2W4683	1
I-8	142	8	1.56	26.6	65.4	1.88		2W4683	1
I-9	±45°	8	1.59	28.3	65.1	-0.58		2W4683	ı
I-10	±45°	8	1.61	27.4	66.8	-1.52		2W4683	1
1-11	±45°	8	1.56	27.3	64.8	1.66		2W4683	1
I-12	9/45/90	20	1.57	29.0	63.7	0.46		2w4683	1
1-13	0/45/90	20	1.57	25.2	67.1	1.75		2w4683	1
1-14	0/45/90	20	1.57	25.4	66.9	1.67		2w4683	1
1-15	90°	15	1.59	25.5	67.7	0.39		2W4683	1
I-17	0°	6	1.58	23.4	68.2	1.73		2W4683	11
I-18	90°	15	1.58	22.6	69.9	1.99		2W4683	1
I-19	90°	1 5	1.59	28.2	65.2	-0.54		2w4683	1
I-20	90°	15	1.57	25.7	66.7	1.58		2W4683	1
1-21	90°	15	1.57	27.9	64.7	0.83		2W4683	1
I-22	±45°	8	1.58	24.1	68.6	1.50		2W4683	1
I-35	0/90/45	20	1.58	26.6	66.3	0.65		2W4810	1
I-36	0/90/45	20	1.58	24.0	68.7	1.54		2W4810	1
I-37	0/90/45	20	1.58	26.0	66.8	0.84		2W4810	1
I-38	0/90/45	20	1.60	24.4	69.2	0.15		2W4810	1
1-39	0/90/45	20	1.59	24.9	68.3	0.63		2W481.0	1

LAMINATE PHYSICAL PROPERTIES Material: T300/V378A Prepreg Resin Fiber Void Thick. Lot/ Prepreg Content Content Content per ply (% by wt) (% by vol(% by vol(10-3in.) Batch Spool/Roll Fiber No. Lam. Spec. No. No. Driant Plies Grav. No. 70.5 -0.12 2W4810 1 23.4 0/90/45 I-40 20 1.61 21.7 1.68 2W4810 1 I-41 00 20 1.59 71.1 2W4810 90° 1.60 26.6 67.1 -0.63 1 I-42 20 25.0 1.80 2W4810 1 00 1.57 67.3 I-43 40 2W4810 1 I-44 ±45° 40 1.57 24.0 68.2 2.15 1.44 1.58 25.6 67.0 Avg. 0.02 2.2 2.2 1.19 S.D.

LAMINATE PHYSICAL PROPERTIES Material: HyE 1076J Prepreg Fiber Void Thick. Lot/ Prepreg Resin Batch Lam. Fiber No. Spec. Content Content Content per_ply Spool/Roll (% by wt) (% by vol(% by vol(10-3in.) No. Drient Plies No. Grav. No. -0.371.62 C1-285 1 Jl 900 26.3 67.1 1.13 J2 1.61 C1-285 1 0.0 23.8 68.9 14 -0.341.62 C1-285 1 J3 67.1 ±45° 8 26.2 0.26 1.62 1 J4 C1-285 ±45° 8 24.6 68.7 0.34 1 J5 1.62 C1-285 ±45° 24.3 68.9 8 -0.28 1.62 1 **J**6 ±45° 8 26.1 67.3 C1-285 1 0.40 C1-285 **J7** ±45° 8 1.61 24.7 68.5 1 0.05 C1-285 **J8** ±45° 8 1.62 25.2 68.1 67.2 -0.05 C1-285 1 J9 8 1.62 26.2 ±45° 1 ±45° 1.61 24.9 67.9 0.95 C1-285 J10 8 1 Jll ±45° 1.61 25.6 67.3 0.33 C1-285 8 0.16 C1-285 1 25.7 67.2 J12 ±45° 8 1.62 -1.75 C1-285 1 J13 20 1.65 25.5 69.0 (1)67.7 0.69 C1-285 1 1.61 25.1 J14 20 (1) -0.12C1-285 1 67.7 1.62 25.6 J15 (1)20 -0.73C1-285 1 1.63 25.0 68.8 **J16** 20 (1)0.18 C1-285 1 1.62 24.8 68.5 J17 20 (1) -3.95 C1-285 1 1.64 J18 0 0 б 32.9 61.9 ٥٥ C1-285 37.7 55.3 6 -1.85 J19 1.58 1.62 0.42 C1-285 1 J20 24.1 69.1 20 (1)67.0 1.18 C1-285 1 1.60 25.4 J21 20 (1)0.23 J22 1.62 C1-285 1 (1)20 24.6 68.6 0.10 1.62 **J23** C1-285 1 68.9 (1)20 24.4 0.17 J24 1.62 C1-285 1 24.8 68.5 (1)20 -0.471 1.63 J25 24.9 68.8 C1-285 (1)20 -0.37 1 C1-285 J26 90° 1.63 24.0 69.7 15 1 -0.83 C1-285 **J2**7 69.9 90° 15 1.64 24.2

⁽¹⁾ $(0.45,-45,0.0,-45,45,0.90,0)_s - 20 ply.$

			LA	MINATE P	HYSICAL	PROPERT	IES		
Mate	erial:	нув	1076J						
Lam. No.	Fiber Orient		Spec. Grav.	Resin Content (% by wt)	Fiber Content (% by vol	Void Content (% by Vol	Thick. per ply	Prepreg Lot/ Batch No.	Prepreg Spool/Roll No.
J28	90°	15	1.64	25.0	69.1	-1.14		C1-285	1
J29	90°	15	1.63	24.9	68.8	-0.47		C1-285	1
J30	90°	15	1.64	24.4	69.6	-0.70		C1-285	1
J31	90°	20	1.63	24.5	69.3	-0.55		C1-285	1
J32	0°	20	1.63	24.0	69.7	-0.38		C1-285	1
J33	±45°	40	1.62	26.3	66.9	-0.17		C1-285	1
J34	±45°	40	1.62	24.8	68.4	0.17		C1-285	1
									-
Avg.			1.62	25.6	68.0	÷0,			
s.D.			0.01	2.6	1.5				
						·			
			4						
								<u> </u>	

Negative void contents can be computed if the assumed resin and fiber specific gravities are not precisely accurate, or if the measured composite specific gravity or resin content is not exact. In any case, they reflect a low void content and are assumed here to represent a void free, or zero void content condition.

LAMINATE PHYSICAL PROPERTIES

Material: G-160/6535-1

Lam. No.	Fiber Orient		Spec. Grav.	Resin Content (% by wt)	Fiber Content (% by vol	Void Content (% by Vol	Thick. per ply	Prepreg Lot/ Batch No.	Prepreg Spool/Roll No.
к3	±45°	8	1.60	25.7	68.0	0.28			440
K4	±45°	8	1.60	26.6	67.1	-0.89			
K5	±45°	8	1.60	25.8	67.9	-0.60			
K6	±45°	8	1.61	26.1	68.0	-1.32			
к7	±45°	8	1.61	26.8	67.2	-1.36			
к8	±45°	8	1.60	25.6	67.9	-0.32			
к9	±45°	8	1.61	26.5	67.6	-1.48			
K10	±45°	8	1.61	26.3	67.6	-1.21			
Kll	±45°	8	1.60	25.5	68.3	-0.70			
K12	0°	6	1.62	26.0	68.3	-2.13			
K13	0.	6	1.63	23.6	71.3	-1.92			
Kl4	90°	15	1.61	25.9	68.3	-1.47			
K15	90°	15	1.61	25.6	68.6	-1.37			
Kl6	90°	15	1.61	<u>~5.9</u>	68.3	-1.49			
K17	90°	15	1.62	25.4	69.0	-1.49			
Kl8	90 °	1,5	1.59	27.3	66.1	-0.19			
Kl9	90°	21	1.62	22.9	71.5	-1.00			
K20	0°	40	1.61	24.4	69.6	-0.72			
K21	0°	21	1.62	23.4	70.5	-0.37			
K24	(1)	20	1.61	26.3	67.8	-1.42			
K25	(1)	20	1.61	26.1	68.0	-1.33			
к26	(1)	20	1.61	25.3	68.7	-1.07			
к34	(2)	16	1.62	26.4	68.2	-2.06			441
K3 5	(2)	16	1.60	26.2	67.6	-0.95			
K36	(2)	16	1.61	26.9	67.3	-1.63			
к37	(3)	20	1.60	26.7	67.1	-0.70			
к38	(3)	20	1.60	26.6	67.3	-1,70			1

^{(1) (0,45,-45,0,0,-45,45,0,90,0)&}lt;sub>s</sub>-20 ply (2) (0,45,-45,0,0,-45,45,0)_s-16 ply (3) (0,90,45,-45,0,0,-45,45,0,0)_s-20 ply

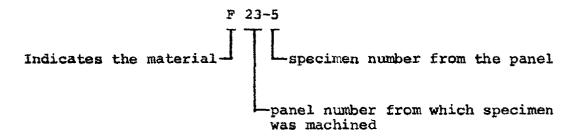
			LA	MINATE P	HYS ICAL	PROPERT	IES	القوارجي استكان فوارضي ده.	
Mate	rial:	G-16	60/6535-1						
Lam. No.	Fiber Orient		Spec. Grav.	Resin Content (% by wt)	Fiber Content (% by vol	Void Content (% by Vol	Thick.	Prepreg Lot/ Batch No.	Prepreg Spool/Roll No.
K39	(3)	20	1.61	25.9	68.3	-1.49			441
K40	±45°	40	1.61	25.7	68.3	-0.97			
K41	0°	14	1.62	23.9	70.6	-1.39			
K42	90°	14	1.61	25.6	68.6	-1.36			
K43	90 °	14	1.61	24.9	68.9	-0.68			
K44	90°	21	1.60	25.4	68.1	-0.24			
K45	90°	15	1.61	25.7	68.4	-1.19			
Avg.			1.61	25.7	68.4	± 0 ¹			
Std.D	v.		0.01	1.0	1.2				
									
							·		

Negative void contents can be computed if the assumed resin and fiber specific gravities are not precisely accurate, or if the measured composite specific gravity or resin content is not exact. In any case, they reflect a low void content and are assumed here to represent a void free, or zero void content condition.

APPENDIX D TENSION DATA

All of the tension data generated during this program are listed in this section. These data are summarized and presented in both tabular and graphical form in Sections 4.1 through 4.6.

The specimen numbering notation used in this and subsequent appendices is illustrated in the example below.



F - T300/AFR800

G - SiC/5506

H - HYE 2034D

I - T300/V378A

J - HyE 1076J

K - G-160/6535-1

Spec. Fiber Test Ultimate Initial Stress at Ultimate No. Orien. Temp. Strength Modulus Prop. Lin. Strain Strain E.4 Colen. Temp. 20.37 178.6 0.33 8.700 F5-7 178.6 20.37 178.6 0.33 8.700 F5-1 0.0 -67 178.5 20.36 178.6 F5-1 0.0 -67 191.5 20.37 178.6 F5-1 0.0 -67 191.5 20.37 186.7 F5-1 0.0 -67 172.2 20.37 186.7 Std.bcw 186.7 20.37 186.7 0.31 8.700 F5-1 0.0 72 186.6 19.18 0.01 8.200 F5-2 0.0 72 169.6 19.18 169.6 0.31 8.700 F5-3 0.0 0.0 10.30 15.0 0.31 8.700 <th>Test:</th> <th>Tension</th> <th></th> <th></th> <th>Mate</th> <th>Material: r300</th> <th>T300/AFR800</th> <th></th> <th></th>	Test:	Tension			Mate	Material: r300	T300/AFR800		
c. Piber Temp. Strength Modulus Prop.Lin. Prop.Lin. Pols. Strain c. Ozien. (**si) (106ps.) (*ksi) Ratio (u.in/in) c. Ozien. 178.6 20.38 178.6 0.33 8.200 c. Ozien. 212.1 21.21 0.32 9.400 c. Ozien. 172.5 20.37 172.5 0.33 8.700 c. Ozien. 186.7 20.37 186.7 0.32 9.400 c. Ozien. 186.7 20.37 186.7 0.33 8.400 c. Ozien. 186.0 0.31 8.400 0.53 8.400 c. Ozien. 186.0 18.83 186.0 0.31 8.700 c. Ozien. 186.0 18.83 186.0 0.33 8.400 c. Ozien. 18.83 186.0 0.31 8.700 c. Ozien. 18.86 186.0 0.31 8.700 c. Ozien. 18.86 186.0 0.31 8.700 c. Ozien. 18.86 </th <th></th> <th></th> <th>Test</th> <th>Ultimate</th> <th></th> <th>Stress at</th> <th></th> <th>Ultimate</th> <th></th>			Test	Ultimate		Stress at		Ultimate	
0° -67 178.6 20.37 178.6 0.32 0° -67 178.9 20.38 178.9 0.33 0° -67 172.2 21.46 212.1 0.32 0° -67 191.5 20.95 191.5 0.33 1 0° -67 186.7 0.31 0.32 1 0° -72 186.0 18.85 186.0 0.31 0° 72 186.0 19.15 169.6 0.31 0° 72 169.6 19.15 169.6 0.31 0° 72 169.6 19.15 169.6 0.31 0° 72 175.1 19.86 175.6 0.32 0° 72 175.6 175.6 0.32 0° 260 174.3 20.14 174.3 0.28 0° 260 175.6 177.7 19.89 177.4 0.28 0° 260 204.0	Spec. No.		Temp. (°F)	Strength (ksi)		Prop.Lim. (ksi)	Pois. Ratio	Strain	Remarks
CO -67 178.9 20.36 178.9 0.33 CO -67 212.1 21.46 212.1 0.32 CO -67 191.5 20.95 191.5 0.33 Sev. 15.8 0.49 15.8 0.01 Dev. 72 186.0 18.85 186.0 0.31 Sev. 72 169.6 18.85 186.0 0.31 Sev. 72 169.6 18.85 186.0 0.31 Sev. 72 169.6 18.85 175.1 0.33 Sev. 72 175.1 19.86 175.1 0.33 Sev. 72 175.1 19.86 175.1 0.35 Sev. 17.0 0.98 170.0 0.20 Sev. 174.3 0.03 0.35 Sev. 174.3 0.29 0.36 Sev. 175.1 19.86 174.3 0.29 Sev. 175.2 20.14<	7-4		-67	178.6	20.37	178.6	0.32	3,400	
00 -67 212.1 21.46 212.1 0.32 00 -67 191.5 20.95 191.5 0.33 1 00 -67 172.2 20.87 186.7 0.30 1 1 15.8 0.49 15.8 0.01 1 0 72 186.0 18.85 186.0 0.31 1 0 72 169.6 19.15 169.6 0.31 1 0 72 169.6 19.15 169.6 0.31 1 0 72 169.6 19.15 169.6 0.31 1 0 72 161.6 18.39 161.6 0.33 1 0 72 170.6 170.6 0.35 0.35 1 0 17.0 0.98 17.0 0.03 1 0 260 174.3 20.14 174.3 0.29 1 0 260 174.3 20.	3-7	D O	-67	178.9	20.38	178.9	0.33	8,200	A STATE OF THE PROPERTY OF THE
0.0 -67 191.5 20.95 191.5 0.30 0.0 -67 172.2 21.21 172.2 0.30 0.0 -67 172.2 21.21 172.2 0.30 0.0 72 186.0 15.85 186.0 0.31 0.0 72 169.6 19.15 169.6 0.33 0.0 72 169.6 19.15 169.6 0.31 0.0 72 169.6 19.15 169.6 0.33 0.0 72 169.6 19.15 169.6 0.33 10.0 72 169.6 19.15 169.6 0.33 10.0 72 169.6 17.22 205.6 0.35 10.0 72 170.0 0.98 170.0 0.03 10.0 170.0 170.0 0.98 170.0 0.03 10.0 260 176.7 19.86 176.7 0.30 10.0 260 170.0 </td <td>1-2</td> <td>00</td> <td>-67</td> <td>212.1</td> <td>21.46</td> <td>212.1</td> <td>0.32</td> <td>9,400</td> <td></td>	1-2	00	-67	212.1	21.46	212.1	0.32	9,400	
0.0 -67 172.2 21.21 172.2 0.30 0ev. 186.7 20.87 186.7 0.32 10ev. 15.8 0.49 15.8 0.01 0 72 186.0 18.85 186.0 0.31 0 72 161.6 18.39 161.6 0.23 0 72 205.6 17.22 205.6 0.29 1 0 72 175.1 0.35 0.29 1 0 72 175.6 18.69 175.1 0.35 1 0 72 175.1 19.86 175.1 0.29 1 0 72 175.6 18.69 175.1 0.33 1 0 260 176.7 19.86 175.6 0.39 1 0 260 2104.0 20.40 174.3 0.28 1 0 260 2104.0 20.40 193.9 0.31 1 <td>[- </td> <td>00</td> <td>29-</td> <td>191.5</td> <td>20.95</td> <td>191.5</td> <td>0.33</td> <td>8,700</td> <td></td>	[-	00	29-	191.5	20.95	191.5	0.33	8,700	
Dev. 186.7 20.87 186.7 0.32 10.4 15.8 0.49 15.8 0.01 10.0 72 186.0 18.85 186.0 0.31 10.0 72 161.6 18.35 161.6 0.33 10.0 72 165.6 18.86 175.1 0.29 10.0 72 175.1 19.86 175.1 0.35 10.0 72 175.6 18.69 175.1 0.35 10.0 72 175.1 19.86 175.1 0.35 10.0 260 176.7 18.69 175.0 0.03 10.0 260 176.7 19.82 176.7 0.36 10.0 260 204.0 20.40 20.40 0.36 10.0 260 204.0 20.40 0.36 10.0 260 204.0 20.40 0.36 10.0 260 204.0 20.40 0.36 10.0 260 204.0 20.40 0.36 10.0 260 204.0 20.40 0.36 10.0 260 204.0 20.40 0.36 10.0 350 185.9 19.39 </td <td></td> <td>00</td> <td>-67</td> <td>172.2</td> <td>21.21</td> <td>172.2</td> <td>0.30</td> <td>006'4</td> <td></td>		00	-67	172.2	21.21	172.2	0.30	006'4	
Dev. 15.8 0.49 15.8 0.01 00 72 186.0 16.85 186.0 0.31 3 00 72 161.6 13.39 161.6 0.33 30 72 161.6 18.39 161.6 0.27 30 72 205.6 17.22 205.6 0.29 30 72 175.1 19.86 175.1 0.39 30 260 176.7 19.82 170.0 0.03 4 00 260 176.7 19.82 170.0 0.03 5 00 260 176.7 19.82 176.7 0.30 6 260 204.0 20.40 204.0 0.28 7 260 201.2 20.40 204.0 0.32 8 00 260 201.2 20.40 193.9 0.32 9 350 193.9 20.40 193.9 0.32 10 350 185.8 19.39 147.5 0.40 10 350 147.5 19.89 147.5 0.40 10 350 200.9 20.37 20.30 0.33 10 350	٧٩.			86.	0	186.7	0.32	•	
0° 72 186.0 18.85 186.0 0.31 0° 72 169.6 19.15 169.6 0.33 0° 72 161.6 13.39 161.6 0.27 0° 72 205.6 17.22 205.6 0.29 1 0° 72 175.1 19.86 175.1 0.39 1 0° 260 174.3 20.14 174.3 0.29 0° 260 176.7 19.82 176.7 0.30 0° 260 204.0 20.40 20.40 0.28 0° 260 213.3 20.40 20.40 0.32 0° 260 213.3 20.40 0.32 0.32 1 0° 260 201.2 20.40 0.32 1 0° 260 201.2 20.40 0.32 1 0° 350 185.8 19.51 173.8 0 0°	의	,			0.49	15.8	0.01	570	
00 72 186.0 19.15 186.0 0.31 00 72 169.6 19.15 169.6 0.33 0 72 161.6 17.22 205.6 0.27 0 72 205.6 17.22 205.6 0.29 1 17.0 0.98 175.1 0.35 1 0 260 174.3 20.14 174.3 0.29 0 260 260 176.7 19.82 176.7 0.30 0 260 204.0 204.0 0.30 0 260 204.0 20.40 204.0 0 260 204.0 20.30 1 0 260 201.2 20.40 2 20 20.40 20.33 1 0 260 201.2 20.40 1 0 20.40 193.9 0.31 0 0 260 20.40 0.40 <t< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>									
0°0 72 169.6 19.15 169.6 0.33 3 0° 72 161.6 18.39 161.6 0.27 0° 72 205.6 175.1 0.29 0.29 0° 72 175.1 19.86 175.1 0.35 1 17.6 18.69 179.6 0.31 1 0° 260 174.3 20.14 17.0 0.03 1 0° 260 174.3 20.14 174.3 0.29 0° 260 176.7 19.82 176.7 0.30 0° 260 204.0 20.40 20.36 0° 260 213.3 20.40 20.35 1 0° 260 201.2 20.36 1 0° 250 201.2 20.15 1 0° 250 201.2 20.40 0.31 0 0° 350 147.5 0.30 0	1-3	00	7.2	186.0	18.85	186.0	0.31	000'6	
3 0° 72 161.6 18.39 161.6 0.27 0° 72 205.6 17.22 205.6 0.29 0° 72 175.1 19.86 175.1 0.35 1 0° 260 174.3 20.14 17.0 0.30 1 0° 260 174.3 20.14 174.3 0.29 0° 260 176.7 19.82 176.7 0.30 0° 260 204.0 20.40 0.28 0.30 0° 260 213.3 20.36 213.3 0.32 1 0° 260 201.2 20.40 0.38 1 0° 260 201.2 20.40 0.34 1 0° 350 185.8 19.51 185.8 0.32 0 350 147.5 19.88 159.7 0.40 0 350 147.5 20.9 0.36 0 350<	3-1	c 0	7.2	169.6	19.15	169.6	0.33	8,400	
0° 72 205.6 17.22 205.6 0.29 0° 72 175.1 19.86 175.1 0.35 1 1 1 17.0 0.98 17.0 0.03 1 0° 260 174.3 20.14 17.0 0.29 0° 260 176.7 19.82 176.7 0.30 0° 260 213.3 20.40 204.0 0.28 0° 260 213.3 20.40 193.9 0.32 1 0° 260 201.2 20.40 193.9 0.34 1 0° 350 185.8 19.51 185.8 0.37 0° 350 147.5 19.39 147.5 0.40 0° 350 173.6 20.09 0.36 0° 350 173.5 20.09 0.36 0° 350 173.5 20.09 0.36 0° 350 173.5 <t< td=""><td>3-13</td><td>00</td><td>7.2</td><td>161.6</td><td>18.39</td><td>161.6</td><td>0.27</td><td>8,200</td><td></td></t<>	3-13	00	7.2	161.6	18.39	161.6	0.27	8,200	
5 0° 7° 175.1 19.86 175.1 0.35 Dev. 179.6 18.69 179.6 0.31 19.90 170 0.98 17.0 0.03 11 0° 260 174.3 20.14 174.3 0.29 3 0° 260 204.0 20.40 204.0 0.28 7 0° 260 213.3 20.38 213.3 0.32 13 0° 260 201.2 20.76 201.2 0.34 19.90 20.76 201.2 0.34 19.90 20.76 201.2 0.34 17.4 0.40 193.9 0.31 16 0° 350 185.9 19.89 159.7 0.32 11 0° 350 173.5 19.39 147.5 0.40 2 0° 350 173.6 20.37 173.8 3 0° 350 200.9 20.22 200.9 0.33 173.5 19.87 173.5 0.36 173.5 19.87 173.5 0.36	3-E	00	72	205.6	17.22	205.6	0.29	9,700	
179.6 18.69 179.6 0.31 8 17.0 0.98 17.0 0.03 11 00 260 174.3 20.14 174.3 0.29 8 3 00 260 204.0 20.40 204.0 0.28 9 13 00 260 201.2 20.36 213.3 0.32 9 13 00 260 201.2 20.76 201.2 0.34 9 17.4 0.44 17.4 0.30 6 00 350 185.9 19.51 185.8 0.37 9 147.5 19.89 147.5 0.30 7 1 00 350 170.7 19.88 159.7 0.32 7 1 00 350 173.6 20.37 173.8 8 3 00 350 200.9 20.22 200.9 0.33 9 173.5 19.87 173.5 0.36 8 173.5 19.87 173.5 0.36 8	5-5	00	72	175.1	19.86	175.1	0.35	8,200	
Dev. 17.0 0.98 17.0 0.03 11 0° 260 174.3 20.14 174.3 0.29 3 0° 260 176.7 19.82 176.7 0.30 3 0° 260 204.0 20.30 0.30 13 0° 260 201.2 20.40 20.3 0.32 13 0° 260 201.2 20.76 201.2 0.34 1. 0° 260 201.2 20.40 0.32 0.34 1. 0° 260 201.2 20.40 193.9 0.34 1. 0° 350 185.8 19.59 0.32 1. 0° 350 147.5 19.89 147.5 0.40 1. 0° 350 147.5 173.8 3 0° 350 200.9 20.37 173.5 0.36 1 0° 350 173.5 0.36 0.36 1 0° 350 20.9 0.30 0.36	79.			179.6	18.69	179.6	0.31	8,700	
11 0° 260 174.3 20.14 174.3 0.29 3 0° 260 176.7 19.82 176.7 0.30 13 0° 260 204.0 20.40 204.0 0.28 13 0° 260 201.2 20.76 201.2 0.34 19.0° 260 201.2 20.76 201.2 0.34 19.0° 260 201.2 20.76 201.2 0.34 19.0° 350 185.3 19.89 159.7 0.32 11 0° 350 173.6 20.37 173.8 3 0° 350 173.6 20.37 173.8 3 0° 350 173.6 20.37 173.8 3 0° 350 200.9 20.22 200.9 0.33 1 0° 350 173.5 19.87 173.5 0.36 1 0.0° 350 200.9 20.22 200.9 0.33 1 0° 350 21.0 0.43 21.0 0.04	td.Dev			17.0	0.98	-	0.03	650	
11 0° 260 174.3 20.14 174.3 0.29 3 0° 260 176.7 19.82 176.7 0.30 3 0° 260 204.0 20.40 204.0 0.28 13 0° 260 213.3 20.88 213.3 0.32 13 0° 260 201.2 20.40 193.9 0.34 1 193.9 20.40 193.9 0.34 1 17.4 0.44 17.4 0.02 1 0° 350 185.8 19.51 185.8 0.32 1 0° 350 147.5 19.88 159.7 0.32 1 0° 350 173.8 3 0° 350 200.9 20.37 173.8 3 0° 350 200.9 0.36 0 350 200.9 20.09 0.36 0									
3 0° 260 176.7 19.82 176.7 0.30 3 0° 260 204.0 204.0 204.0 0.28 7 0° 260 213.3 20.88 213.3 0.32 13 0° 260 201.2 20.76 201.2 0.34 . Dev. 193.9 20.40 193.9 0.31 . Dev. 17.4 0.44 17.4 0.02 16 0° 350 185.8 19.51 185.8 0.32 11 0° 350 147.5 19.88 159.7 0.32 1 0° 350 173.8 20.37 173.8 3 0° 350 173.8 20.37 173.8 3 0° 350 173.8 20.37 173.8 3 0° 350 200.9 20.32 200.9 0.33 . Dev. 21.0 0.43 21.0 0.04	1-11	00	260		0	4	0.29	8,400	
3 00 260 204.0 20.40 204.0 0.28 7 00 260 213.3 20.88 213.3 0.32 13 00 260 201.2 20.76 201.2 0.34 .Dev. 193.9 20.40 193.9 0.31 .Dev. 17.4 0.44 17.4 0.02 6 00 350 185.8 19.51 185.8 0.37 11 00 350 147.5 19.88 159.7 0.32 10 00 350 173.8 20.37 173.8 350 200.9 200.9 20.22 200.9 0.33 .Dev. 21.0 0.43 21.0 0.04	3-3	0.0	260	1	19.82	176.7	0.30	8,400	
7 0° 260 213.3 20.38 213.3 0.32 13 0° 260 201.2 20.76 201.2 0.34 . 193.9 20.40 193.9 0.31 . 17.4 0.44 17.4 0.02 . 17.4 0.44 17.4 0.02 . 0 350 185.8 19.51 185.8 0.37 . 0° 350 147.5 19.88 159.7 0.40 . 0° 350 147.5 19.39 147.5 0.40 . 0° 350 173.8 . 0° 350 200.9 0.33 . 173.5 19.87 173.5 0.36 . 21.0 0.43 21.0 0.04	1-3	00	260		20.40	204.0	0.28	9,400	
13 0° 260 201.2 20.76 201.2 0.34 .	5-7	00	260	- 1	20.38	213.3	0.32	9,800	
. bev. 193.9 20.40 193.9 0.31	5-13	6 0	260		20.76		0.34	9,200	
bev. 17.4 0.44 17.4 0.02 6 0° 350 185.3 19.51 185.8 0.37 16 0° 350 147.5 19.88 159.7 0.32 11 0° 350 147.5 19.39 147.5 0.40 7 0° 350 173.8 3 0° 350 200.9 20.32 200.9 0.33 . 173.5 19.87 173.5 0.36 . 21.0 0.43 21.0 0.04	rg.				20.40	93.	0.31	9,040	
6 0° 350 185.8 19.51 185.8 0.37 16 0° 350 159.7 19.88 159.7 0.32 11 0° 350 147.5 19.39 147.5 0.40 7 0° 350 173.8 3 0° 350 200.9 0.33 . 173.5 19.87 173.5 0.36 . 21.0 0.43 21.0 0.04	td.Dev			۲.	1 • 1	7		620	
6 0° 350 185.8 19.51 185.8 0.37 16 0° 350 159.7 19.88 159.7 0.32 1 0° 350 147.5 19.39 147.5 0.40 3 0° 350 200.9 20.37 173.8 3 173.5 19.87 173.5 0.36 6 173.5 19.87 173.5 0.36 7 21.0 0.43 21.0 0.04									
16 0° 350 159.7 19.88 159.7 0.32 11 0° 350 147.5 19.39 147.5 0.40 7 0° 350 173.8 3 0° 350 200.9 20.22 200.9 0.33 . 173.5 19.87 173.5 0.36 . 21.0 0.43 21.0 0.04	1-6	00	350	185.3	4	•	0.37	1	
11 0° 350 147.5 19.39 147.5 0.40 77 0° 350 173.8 173.8 0° 350 200.9 20.22 200.9 0.33 1.0 173.5 0.36 1.0 0.43 21.0 0.04	1	00	350	159.7	19,88	159.7	0.32	7,700	
7 0° 350 173.8 20.37 173.8 3 0° 350 200.9 20.22 200.9 0.33 	3-11	00	350	147.5	19.39	147.5	0.40	7,500	
3 00 350 200.9 20.22 200.9 0.33 . 173.5 19.87 173.5 0.36 .Dev. 21.0 0.43 21.0 0.04	1-7	00	350	173.8	20.37	173.8		8,100	
. Dev. 173.5 19.87 173.5 0.36 8.	5-3	00	350	200.9	20.22	200.9	0.33	9,400	
Dev. 21.0 0.43 21.0 0.04	79.			73	Φ.	173.5	0.36	4	
	rd.Dev			21.0	•	21.0	0.04	870	

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Test:	Tension			Mati	Material: AFR-800	-800		
		Test	Ultimate	Initial	Stress at	,	Ultimate	
Spec. No.	Fiber Orien.	Temp.	Strength (k3i)	Modulus (10 ⁶ psi)	Frop. Lim. (ksi)	Pols. Ratio	btrain (u in/in)	Remarks
F7-8	006	19-	4.55	1.56	4.55	1	2,940	
F8-8	006	-67	4.58	1.63	1.60	1	2,875	
F9-10	6 06	-67	5.19	1,58	5.19	*	3,015	
F11-5	006	-67	2.80	1.70	1.20		1,695	
F12-2	006	-67	6,31	1.70	1.93		3,825	
Avg.			4.69	1.63	2.89	1	2,870	
Std.Dev			1.27	• •	1.84	i i	760	
F7-9	္ ေ	72	•	1.47	4.90	1 1	3,325	
F8-9	0 06	72	5.75	1.47	4.58	1 1	3,950	
F11-1	o06	72	5.14	1.49	4.26		3,450	
F12-5	006	7.2	3.20	1.55	3.20	} }	2,075	
F13-7	006	72	3.93	1.44	3.93	1	2,750	
Avg.			4.58	1.48	4.17	1	3,110	
Std.Dev			1.01	0.04	0.65	4 9 2	720	
F8-5	06	260	5.56	1.38	5.56	2 2 5	4,050	
F9-9	066	260	4,40	1.31	4.20		3,500	
F11-2	006	260	4.33	1.39	2.46	1 1 1	3,200	
F12-8	006	260	4.53	1.33	2.93	**	3,500	
F12-10	006	260	4.59	1.41	3.78	***	3,290	
Avg.			4.68	1.36	3.79		3,510	
Std.Dev			0.50	0.04	1.21	# 11 %	330	
F7-1	o06	350	5,19	1.20	2.08		4,550	
F8-3	906	350	5.08	1.26	1.59	1 1	4,275	
F9-1	906	350	4.80	1.12	3.72	1	4,350	
F12-7	900	350	5.51	1.26	2.49		4,925	
F13-5	006	350	6.53	1.09	4.40	-	6,450	
Avg.			5.42	1.19	2.86	1	4,910	
Std.Dev			0.67	0.08	1.17	1 - 1	006	

			A STATE OF THE PROPERTY OF THE	17 44.4	Marcital. AFR-800	800		
		Test	Ultimate	Initial	Stress at		Ultimate	
Spec.	Fiber	Temp.	بد		Prop. Lim.	Pois.	Strain	
202	Orren.	73.1	17:37	(rsd_or)	(KSI)	RACIO	(n in/in)	Kellarks
F23-5	±450	-67	27.81	2.37	11.57	0.68	+009'6	
F24-1	+450	-67	26.73	2.31	9.58	0.72	10,600+	
F25-7	£450	-67	25.69	2.22	11.57	0.71	14,800	
F26-4	±450	-67	25.24	2.10	60.9	0.62	16,000	
F27-10	±450	-67	26.74	2.39	8.04	0.73	9,400+	
AVG.			25.44	2.28	9,37	0,69	12,080	
Std. Dev			1,00	0.12	2.36	0.04	3,090	
H	±450	7.2	24.07	2.31	4.05	0.73	20,000	
F24-9	±450	72	23.80	2.45	6.45	0.72	16,600	
F25-5	±450	7.2	21.50	2.09	3.41	0.74	18,350	
F26-10	±450	7.2	23.70	2.40	4.67	0.82	17,400	
F27-1	1450	72	23.14	2.50	4.87	0.74	15,800	
f . 1			23.24	2.35		0.75	17,630	
Std.Dev			1.03	0.16	1.14	0.04	1,630	
F23-11	o57∓	260	18.0	2.26	5.53	0.78	23,100+	
F24-4	1450	260	15.4	2.08	4.55	0.78	11,000	
F25-1	±450	260	17.2	2.24	4.56	0.78	22,000	
i.	±450	260	17.5	2.10	5.22	0.80	32,000	
F27-3	±450	260	15.8	2.01	5.01	0.77	12,800+	
Avg.			16.8	2.14	4.93	0.78	21,580+	
Std.Dev.			1.12	0.11	0.36	0.01	1,090+	
F23-3	±450	350	17.06	1.61	2.05	0.86	46,800+	
F24-7	±450	350	16.37	1.73	2.67	0.94	38,800+	
F25-10	±450	350	17.13	1.71	1.78	0.92	34,000+	
F26-2	±450	350	15.34		1.96	06.0	37,900+	
F27-5	±450	350	15.43		2.17	0.79	39,750+	
Avg.			·i	1.62		0.88	39,450	
Std.Dev			0.86	0.12	0.34	90.0	4,650	

Test:	Tension			Mate	Material: SIC/	SIC/5506		
-	i	Test	Ultimate		Stress at	•	Ultimate	
Spec. No.	Fiber Orien.	Temp.	Strength (ksi)	Mcdulus (10 ⁶ psi)	Prop.Lim. (ksi)	Pois. Ratio	Strain (p in/in)	Remarks
G23-2	00	-67	204.9	33,43	160.5	0.24	7,500	
G23-5	0.0	-67	198.8	31.53	101.8	0.24	7,400	And the second s
623-12	00	-67	235.4	31.40	157.5	0.18	7,600	
623-14	٥٥	-67	233.1	33.50	80.4	0.22	7,900	
623-17	0.0	-67	235.8	31.53	147.4	0.24	7,600	
Avg.			221.6	32.28	129.5	0.22	7,600	
Std.Dev			13.2	1.09	36.2	0.03	190	
623-1	00	7.2	232.1	32.05	92.6	1 1 1	8,100	
G23-6	00	72	241.7	33.50	83.1	0.20	8,800	
G23-11	00	7.2	220.3	33.09	58.2	0.24	7,100	
623-16	00	72	222.9	32.75	9.08	0.23	7,100	
623-19	0.0	72	228.5	35.59	42.7	0.24	7,200	
Avg.			229.1	33.40	71.4	0.23	7,660	
Std.Dev			8.4	1.34	20.4	0.02	760	
ł								
G23-3	0	260	188.1	33.50	85.8	05.0	6,300	ලා
G23-9	00	260	205.0	32.76	9.66	0.24	7,300	e
623-10	00	760	178.8	33.36	74.7	02.0	5,200+	failed @ tab
Avg.			190.6	33.21	86.7	0.25	6,800	*
Std.Dev	1		13.3	0.39	12.5	0.05		
693-17	00	0.0	0,	00 30			.007	
623-15	00	350	161.7	33.00	24.5	0.23	+00%	2014
222	, (330	, , , , ,	25.15	03.0	0.63	2000	2
623-18	20	350	180.7	31.72	67.4	0.49	5.400+	
Avg.			174.5	33.04	57.4	0.32	5,130+	
Std. Dev			11.0	2.39	19,5	0.15	460	
	1							
1								
_			_					

*Excludes G23-10 on which strain gage malfunctioned before end of test

Test:	Tension			Mate	Materiai: SIC	SIC/5506		
		'fest	Ultimate		Stress at		Ultimate	
Spec.	Fiber	Temp.	Strength	_	Prop.Lim.	Pois.	Strain	Remarks
69-7	006	-67	10.27	3.96	5.38		2,880	north and a second the contraction of the contracti
622-2	900	-67	10.44	3.66	7.90	*	2,920	
G24-3	006	-67	8.33	3.90	6.57	1	2,250	
625-4	906	-67	11.55		4.74		3,380	
626-5	906	-67	8.31	3.88	6.26	i .	2,310	
Avg.			9.78		6.17	1	2,750	
Std.Dev			1.42		1.21		470	
G9-3	906	7.2	8,99	2.96	4.98		3.400	
G22-1	906	7.2	10.43	3.13	4,82	-	3,910	
G24-2	006	7.2	9.78	3.07	3.61		3,740	
G25-3	006	7.2	9.62	2.89	3.92	! } &	3,760	
G26-4	A06	72	9.72	2.90			3,830	
AVG.			9.71	2.99			3,730	
Std.Dev			0.51	•	۱ • ۱	5 1	190	
69-4	906	260	6.34	2.09	2.78	1 2 1	4,760	
622-3	906	260	6.56	1.88	2.76		4,990	
624-1	006	260	6.38	2.17	2.64		4,090	
525-6	906	260	6.55	1.97	3.10	:	4,640	
G26-1	606	260	6.39	1.77	2.91		5,000	
Avg.			6.44	1.97	2.84	i	4,700	
Std.Dev			0.104	0.16	0.18	1	370	The section of the se
								4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4
6-65	900	350	3,84	0.91	1.62	1	6.000	
522-5	906	350	4.39	1.10	1.65	1	7 500	
G24-4	906	350	4.92	1.19	1.96		8,250	
625-C	906	350	4.40	1.13	-	** **	8,500	
2-92-5	.06	350	4.14	0.89	1.76	1	7,500	
Avg			4.34	1.04	•1		7,550	
Std.Dev			0.40	0.13	0.13	1	980	

Test Temp. Orien. (°F) ±450 -67 ±450 -67 ±450 -67 ±450 72 ±450 260 ±450 260 ±450 350 ±450 350 ±450 350 ±450 350	Ultimate Strength (ksi) 20.63 20.24 20.41 17.69 19.66 19.66 19.72	Initial Modulus (106psi) 3.93 3.50 3.50	Stress at Prop.Lim.		Ultimate Strain	
Fiber Temp. Orien. (°E) ±450 -67 ±450 -67 ±450 -67 ±450 -67 ±450 72 ±450 72 ±450 72 ±450 72 ±450 72 ±450 260 ±450 260 ±450 260 ±450 260 ±450 260 ±450 260 ±450 260 ±450 260 ±450 260 ±450 260 ±450 260 ±450 260 ±450 260 ±450 260 ±450 260 ±450 350 ±450 350	Strength (ksi) 20.63 20.24 .20.41 .17.69 19.66 19.66 19.66 17.69		Prop.Lim.	Doise	Strain	
ev. 1450 -67 -67 -67 -67 -67 -67 -67 -67 -67 -67	20.63 20.63 20.24 17.69 19.66 19.72 1.19	3.93 3.93 3.50 3.50				
#450 - 6 - 6 - 6 - 6 - 6 - 6 - 6 - 6 - 6 -	20.63 20.24 17.69 19.66 19.72 1.19	3.50	1703)	Ratio	(h 1n/1n)	Kemarks
ev	20.24 .20.41 17.69 19.66 19.72 1.19	3.50	5.70	0.66	9,350	
#450 - 6 #450 - 6 #450 - 7 #450 - 7 #450 - 7 #450 - 2 #450 - 2 #450 - 3 #450 - 3 #450 - 3 #450 - 3	.20.41 17.69 19.66 19.72 1.19	3.50	6.48	0.73	008'6	
ev.	17.69 19.66 19.72 1.19	3.50	5.97	0.59	N.A.	Gage failed during
#4506 #4506 #4507 #4507 #4508 #4508 #4508 #4508 #4508 #4508 #4508 #4508 #4508	19.66 19.72 1.19 17.69	,	5.96	0.59	7,050	test
ev	19.72	3.67	7.13	0.72	8,200	
EV. 1450 77 1450 77 1450 77 1450 8V. 1450 22 1450 22 1450 33 1450 33 3450 3450	1.19	3.71	6.25	0.66	8,600	
#450 7 450 7 4450 7 4450 7 4450 7 4450 3 3 4450 3 3 3 4450 3 3 3 4450 3 3 3 3 4450 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	17.69	0.22	0.57	0.07	123	
#450 7 #450 7 #450 7 #450 8 # #################################	17.69					
#450 7 #450 7 #450 7 #450 2 #450 2 #450 3 #450 3		2.65	6.76	0.69	15,950	
#450 7 4450 7 4450 3 4450 3 3 4450 3 3 3 4450 3 3 3 4450 3 3 3 4450 3 3 3 4450 3 3 3 4450 3 3 3 3 4450 3 3 3 3 3 3 4450 3 3 3 3 3 3 4450 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	16.52	2.96	4.80	•	14,700	
#450 22 2 4450 2 4450 3 3 4450 3 3 3 4450 3 3 3 4450 3 3 3 4450 3 3 3 4450 3 3 3 4450 3 3 3 3 4450 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	17.52	3.08	4.81	0.80	15,900	
#450 #450 #450 #450 #450 #450 #450 #450	17.95	3.40	4.90		15,200	
t 450 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	16.92	2.75	4.42	0.86	15,800	
#450 #450 #450 #450 #450 #450 #450 #450	17.32	2.97	5.14	0.74	15,510	
±450 2 ±450 2 ±450 2 ±450 2 ±450 3 ±450 3	0.58	0.30	0.92	0.08	540	
#450 2 #450 2 #450 2 #450 2 #450 3		•				
#450 2 #450 2 #450 2 #450 3 #450 3		1.96	1.86	0,93	42,000+	Strain exceeded
#450 2 #450 2 #450 2 #450 3 #450 3	12.45	1.35	1.32	•	40,500+	
1450 2 1450 2 1450 3 1450 3	12.25	1.86	2.04	0.78	34,500+	
#450 2 #450 3 #450 3 #450 3	10.66	1.57	1.13	1.02	23,500+	
1450 3 1450 3 1450 3		1.40	1.57	•	4000'SE	
4450 3 1450 3 1450 3	•	1.63	1.59	0.89	35,100+	
1450 3 1450 3 1450 3	0.84	0.27	•	0.11	7,270	
1450 3 1450 3 1450 3	- 1		- 1			
1450 3	7.98	0.77	1.44	0.57	35,000+	Strain exceeded
±450 3	7.90	0.39	0.83	0.75	35,000÷	gage limit
1450 3	7.90	0.65	0.98	0.71	20,000+	
	8.17	0.39	0.66		79,500+	
-5 1450 3	. 7.67	0.36	0.67	0.83	35,000+	
Avg.		0.51	0.93	• • •	+006'08	
Std.Dev.	0.18	0.19"	0.32	0.11	6,540	

nate Initial Modulus (106psi)				Mat	Material: SIC	SIC/5506		
Fiber Temp. Strength Modulus Orien. (°F) (k3i) (106psi) (106psi) $0/\pm 45/90$ 72 125.6 21.33 $0/\pm 45/90$ 72 125.2 19.42 $0/\pm 45/90$ 72 105.9 19.42 $0/\pm 45/90$ 72 108.6 20.54 $0/\pm 45/90$ 260 110.6 19.0 $0/\pm 45/90$ 260 110.7 19.0 $0/\pm 45/90$ 260 110.7 2 19.1 17.3 $0/\pm 45/90$ 350 107.0 18.7 0.4 $0/\pm 45/90$ 350 107.2 18.1 17.3 $0/\pm 45/90$ 350 107.2 18.1 20.6 $0/\pm 45/90$ 350 100.2 18.4 $0/\pm 45/90$ 72 105.8 $0/\pm 45/90$ 72 105.8 $0/\pm 45/90$ 72 104.2 $0/\pm 45/90$ 72 104.2 $0/\pm 45/90$ 72 104.2 $0/\pm 45/90$ 72 104.2 $0/\pm 45/90$ 72 104.7 $0/\pm 45/90$ 72 104.7		Test	Ultimate		Stress at		Ultimate	
0/±45/96 72 125.6 21.33 0/±45/96 72 105.9 19.42 0/±45/96 72 108.6 19.38 0/±45/96 72 125.2 19.38 0/±45/96 260 111.7 19.0 0/±45/96 260 110.6 19.0 0/±45/96 260 112.3 18.4 0/±45/96 260 115.6 19.0 0/±45/96 260 115.6 19.0 0/±45/96 350 107.0 18.7 0/±45/96 350 107.0 18.4 0/±45/96 350 107.2 18.1 0/±45/96 350 107.2 18.1 0/±45/96 350 107.2 18.1 0/±45/90 72 104.2 0/±45/90 72 104.2 0/±45/90 72 104.2 0/±45/90 72 104.7 0/±45/90 72 104.7 0/±45/90 72 104.7	Fiber Orien.	Temp. (°F)	Strength (ksi)		Prop.Lim. (ksi)	Pois. Ratio	Strain (uin/in)	Remarks
0/145/96 72 N.A. 23.67 0/145/96 72 105.9 19.42 0/145/96 72 118.0 18.92 0/145/96 72 125.2 19.38 0/145/96 260 110.6 20.54 0/145/96 260 110.6 19.0 0/145/96 260 110.6 19.0 0/145/96 260 112.3 18.4 0/145/96 260 117.2 19.0 0/145/96 350 107.0 18.7 0/145/96 350 102.1 17.3 0/145/96 350 102.1 17.3 0/145/96 350 102.1 17.3 0/145/96 350 102.1 18.1 2v. 6.0 0.6 2/145/99 72 104.2 2/145/90 72 104.2 2/145/90 72 104.2	0/145/90	72	125.6		19.6	N. W.	008'S	
0/445/96 72 105.9 19.42 0/445/96 72 118.0 18.92 0/445/96 72 1125.2 19.38 0/445/96 260 111.7 19.0 0/445/96 260 1126.2 19.10 0/445/96 260 1126.2 19.10 0/445/96 260 1127.3 18.4 0/445/96 260 107.0 18.7 0/445/96 350 107.0 18.7 0/445/96 350 107.0 18.7 0/445/96 350 103.9 18.4 0/445/96 72 105.8 0/445/90 72 105.8 0/445/90 72 106.2 0/445/90 72 106.2 0/445/90 72 106.2 0/445/90 72 106.2	0/145/90	72	N.A.	23.67	21.8	0.18	N.A.	Failed at tab end
0/145/96 72 118.0 18.92 0/445/96 72 125.2 19.38 108.6 20.54 24.9 1.97 0/445/96 260 110.6 19.0 0/445/96 260 110.6 19.0 0/445/96 260 126.2 19.1 0/445/96 260 107.3 18.4 0/445/96 350 107.0 18.7 0/445/96 350 107.0 18.7 0/445/96 350 107.0 18.7 0/445/96 350 107.0 18.7 0/445/96 350 105.8 18.4 0/445/96 72 105.8 0/445/90 72 105.8 0/445/90 72 106.2 0/445/90 72 106.2 0/445/90 72 106.2	0/145/90	72	105.9	19.42	39.3	0.41	5,575	
0/±45/90 72 125.2 19.38 cv. 24.9 1.97 0/±45/90 260 111.7 19.0 0/±45/90 260 113.6 19.0 0/±45/90 260 107.4 19.6 0/±45/90 260 107.4 19.6 0/±45/90 260 107.4 19.6 0/±45/90 350 107.0 18.7 0/±45/90 350 102.1 17.3 0/±45/90 350 102.1 17.3 0/±45/90 350 103.9 18.4 0/±45/90 350 103.9 18.4 0/±45/90 350 103.9 18.1 0/±45/90 72 104.2 0.6 0/±45/90 72 104.2 0.6 0/±45/90 72 104.2 0.6 0/±45/90 72 104.7 0.4 0/±45/90 72 104.7 0.4 0/±45/90 72 104.7 0.6 0/±45/90 72 104.7 0.6 0/±45/90 72 104.7 0.6 0/±45/90 72 104.7 0.6 0/±45/90 72 104.7 0.6	0/145/90	7.2	118.0	18.92	47.4	0.37	5,775	Failed at tab end
0/±45/90 260 111.7 19.0 0/±45/90 260 113.6 19.0 0/±45/90 260 113.6 19.0 0/±45/90 260 1107.4 19.6 0/±45/90 260 1107.4 19.6 0/±45/90 260 1107.2 19.0 ev. 7.7 0.4 0/±45/90 350 102.1 17.3 0/±45/90 350 102.1 17.3 0/±45/90 72 103.9 18.4 0/±45/90 72 104.2 0/±45/90 72 104.2 0/±45/90 72 104.2 0/±45/90 72 104.2 0/±45/90 72 104.2 0/±45/90 72 104.2 0/±45/90 72 104.2	· \	72	125.2	19.38	65.0	0.28	5,750	
cv. 24.9 1.97 0/±45/90 260 111.7 19.0 0/±45/90 260 126.2 19.0 0/±45/90 260 127.3 18.4 0/±45/90 260 107.0 18.4 0/±45/90 350 107.0 18.7 0/±45/90 350 107.0 18.7 0/±45/90 350 107.0 18.7 0/±45/90 350 107.0 18.1 0/±45/90 350 107.2 18.1 0/±45/90 72 107.8 10.6 0/±45/90 72 104.2 0.6 0/±45/90 72 104.2 0.6 0/±45/90 72 104.2 0.6 0/±45/90 72 104.2 0.6 0/±45/90 72 104.2 0.6 0/±45/90 72 104.2 0.4 0/±45/90 72 104.2 0.4 0/±45/90 72 104.7 0.4 0/±45/90 72 104.7 0.6 0/±45/90 72 104.7 0.6 0/±45/90 72 104.7 0.7 0/±45/90 72 104.7 0.7			103.6	20.54	38.6	0.31	5,725	
0/±45/90 260 111.7 19.0 0/±45/90 260 112.6 19.0 0/±45/90 260 126.2 19.0 0/±45/90 260 107.4 19.6 0/±45/90 260 117.2 19.0 ev. 117.2 19.0 0/±45/90 350 107.0 18.7 0/±45/90 350 103.9 18.4 0/±45/90 72 105.8 0/±45/90 72 104.2 0/±45/90 72 104.2 0/±45/90 72 104.2 0/±45/90 72 104.2 0/±45/90 72 104.2 0/±45/90 72 104.2			24.9	1	18.8	0.10	100	
0/±45/90 260 111.7 19.0 0/±45/90 260 126.2 19.1 0/±45/90 260 107.4 19.6 0/±45/90 260 107.4 19.6 0/±45/90 260 117.2 19.0 ev. 7.7 0.4 0/±45/90 350 107.0 18.7 0/±45/90 350 105.1 17.8 0/±45/90 350 105.1 17.8 0/±45/90 72 108.1 0/±45/90 72 104.2 0/±45/90 72 104.2 0/±45/90 72 104.2 0/±45/90 72 104.2 0/±45/90 72 104.2 0/±45/90 72 104.2 0/±45/90 72 104.2								
0/45/90 260 110.6 19.0 0/445/90 260 126.2 19.1 0/445/90 260 107.4 19.6 0/745/90 260 1122.3 18.4 0/445/90 260 117.2 19.0 0/445/90 350 107.0 18.7 0/445/90 350 102.1 17.3 0/445/90 350 102.1 17.3 0/445/90 72 105.8 0/445/90 72 104.2 0/445/90 72 104.2 0/445/90 72 104.2 0/445/90 72 104.2 0/445/90 72 104.2 0/445/90 72 104.2	/442/	260	4	19.0	35.1	0.52	5.650+	*
6/±45/90 260 126.2 19.1 0/±45/90 260 107.4 19.6 0/±45/90 260 117.2 19.0 ev. 117.2 19.0 0/±45/90 350 107.0 18.7 0/±45/90 350 102.1 17.8 0/±45/90 350 103.9 18.4 2v. 6.0 0.6 0/±45/90 72 104.2 2/±45/90 72 104.2 2/±45/90 72 104.2 2/±45/90 72 104.7 2/±45/90 72 104.7 2/±45/90 72 104.7 2/±45/90 72 104.7 2/±45/90 72 104.7 2/±45/90 72 104.7 102.5 102.5 102.5 102.5	1215/	260		19.0	•	9	5,750+	*
0/145/90 260 107.4 19.6 0/145/90 260 1122.3 18.4 0/145/90 260 117.2 19.0 0/145/90 350 107.0 18.7 0/145/90 350 102.1 17.3 0/145/90 350 103.9 18.4 0/145/90 350 103.9 18.4 0/145/90 72 107.2 18.1 0/145/90 72 105.8 0/145/90 72 104.2 0/145/90 72 104.2 0/145/90 72 104.2 0/145/90 72 104.2 0/145/90 72 104.2 0/145/90 72 104.2	145/	260		19.1	06.5	0.34	5,900	
0/145/90 260 122.3 18.4 ov. 117.2 19.0 ov. 145/90 350 107.0 18.7 ov. 145/90 350 103.9 18.4 ov. 107.2 103.9 18.4 ov. 107.2 103.9 18.1 ov. 107.2 104.2 ov. 107.3 104.2 ov. 107.5 104.7 ov. 107.5 104.7	‡45/	260		19.6			059'5	
ev. 117.2 19.0 6.445/90 350 107.0 18.7 6.445/90 350 102.1 17.8 6.445/90 350 102.1 17.3 7.445/90 350 103.9 18.4 8v. 6.0 0.6 7.445/90 72 105.8 7.445/90 72 104.2 7.445/90 72 104.2 7.445/90 72 104.2 7.445/90 72 104.2 7.445/90 72 104.2 7.445/90 72 104.2 7.445/90 72 104.2 7.445/90 72 104.2 7.445/90 72 104.2 7.445/90 72 104.2 7.445/90 72 104.7 7.445/90 72 104.7 7.445/90 72 104.7 7.445/90 72 104.7 7.445/90 72 104.7 7.445/90 72 104.7 7.445/90 72 104.7 7.445/90 72 104.7 7.445/90 72 104.7 7.445/90 72 104.7 7.445/90	145/	260		18.4		0.39	5,750	
ev. 7.7 0.4 0/±45/90 350 107.0 18.7 0/±45/90 350 115.6 17.8 0/±45/90 350 102.1 17.8 0/±45/90 350 103.9 18.1 3v. 6.0 0.6 0/±45/90 72 105.8 0/±45/90 72 104.2 0/±45/90 72 104.2 0/±45/90 72 104.2 0/±45/90 72 104.2 0/±45/90 72 104.2 0/±45/90 72 104.7 102.5 102.5						0.45	5,740	
0/±45/90 350 107.0 18.7 0/±45/90 350 115.6 17.8 0/±45/90 350 102.1 17.3 0/±45/90 350 103.9 18.4 107.2 18.1 6.0 0.6 0/±45/90 72 105.8 0/±45/90 72 104.2 0/±45/90 72 104.2 0/±45/90 72 104.2 0/±45/90 72 104.2 0/±45/90 72 104.2 104.2 102.5 102.5			•		15.0	~	100	
0/±45/90 350 107.0 18.7 0/±45/90 350 115.6 17.8 0/±45/90 350 102.1 17.3 0/±45/90 350 103.9 18.4 107.2 18.1 6.0 0.6 0/±45/90 72 105.8 0/±45/90 72 104.2 2/±45/90 72 104.2 2/±45/90 72 104.2 2/±45/90 72 104.2 2/±45/90 72 104.2						•		
0/±45/9G 350 115.6 17.8 0/±45/9G 350 102.1 17.3 0/±45/9G 350 103.9 18.4 3v. 6.0 0.6 0/±45/90 72 105.8 0/±45/90 72 104.2 2/±45/90 72 104.2 2/±45/90 72 104.2 2/±45/90 72 104.2 2/±45/90 72 104.2 2/±45/90 72 104.2	12021	350	107.0	18.7	50.1	0.46	5,700	
0/±45/90 350 102.1 17.3 0/±45/90 350 103.9 18.4 3v. 6.0 0.6 0/±45/90 72 105.8 0/±45/90 72 104.2 2/±45/90 72 104.2 2/±45/90 72 104.7 2/±45/90 72 104.7 102.5	/+45,	350	115.6	17.8	62.6	0.46	4,425	*
0/±45/90 350 103.9 18.4 3v. 6.0 0.6 0/±45/90 72 105.8 0/±45/90 72 104.2 2/±45/90 72 104.2 2/±45/90 72 104.2 2/±45/90 72 104.7 102.5 v. 3.5	/‡45,	350	102.1	17.3	53.5		2,800	
. bev. 6.0 0.6 -8 0/±45/90 72 105.8 2 0/±45/90 72 97.6 -4 0/±45/90 72 104.2 -1 2/±45/90 72 104.2 -3 0/±45/90 72 100.2 -3 0/±45/90 72 100.2 -3 0/±45/90 72 100.2 -3 0/±45/90 72 102.5	/507/	350	103.9	18.4	74.9	0.37	4,850	
.Dev. 6.0 0.6 -8 0/+45/90 72 105.8 -2 0/±45/90 72 97.6 -4 2/±45/90 72 104.2 -1 2/±45/90 72 100.2 -3 2/±45/90 72 100.2 -3 2/±45/90 72 100.2 -4 2/±45/90 72 100.2 -5 104.7 -6 100.6 -6 105.8 -7 104.2 -7 100.2 -7 100.2 -7 100.2 -7 100.7 -7 100.7	_		107.2	18.1	60.3	•	5,190	
-8 0/+45/90 72 105 -2 0/ ₊ 45/90 72 97 -4 0/ ⁺ 45/90 72 104 -1 2/+5/90 72 104 -3 0/+45/90 72 104 -3 0/+45/90 72 104 -3 0/+45/90 72 104	•		6.0	9.0	11.1	0.06	670	
-8 0/±45/90 72 105 -2 0/±45/90 72 97 -4 0/±45/90 72 104 -1 2/±45/90 72 100 -3 2/±45/90 72 104 								
-2 0/±45/90 72 97 -4 0/±45/90 72 104 -1 2/±45/90 72 100 -3 0/±45/90 72 104 Dev.			105.8					Based on net cross-
-4 b/±45/90 72 104. -1 2/±45/90 72 100 -3 2/±45/90 72 104. Dev.		7.2	97.6					sectional area. Specimens
-1 2/±45/90 72 100. -3 2/±45/90 72 104. .Dev.	06/52790	7.2						had a 0.1935 inch dia-
-3 b/±45/90 72 104.		7.2						meter hole in center of
. Dev. 3.	\sim	7.2	•	,				gage section.
.Dev.			- 4					
			-					

*Tabs debonded, retabbed and tested for strength only, elastic data taken from first test

					MACCALLA AYE	40 34 D		
		Test	Ultimate	Initial	Stress at	•	Ultimate	
Spec.	Fiber	Temp.	Strength	Modulus	Prop. Lim.	Pois.	Strain	\$
NO.	Orien.	(°F.)	(K31)	(TSd_AT)	(ks1)	Katio	(nin/in)	кемагкв
H1-3	0.0	-67	149.6	51.12	149.6		2700	gage falled
H1-10	, 0	-67	108.9	50.61	108.9	0.36	,	tabs debonded
H2-4	0.0	67	105.3	72.46	105.3	1	1500	gage failed
H2-13	, O	-67	4.06	45.41	7.06	0.25	1900	
н1-17	9 0	29	157.0	60.00	157.0	0.29	2500	
Avg.			122.3	55.92	122.3	0.30	2150	
Std.Dev.			29.3	10.63	29.2	90.0	550	
H1-9	0,0	72	151.6	41.75	151.6	0.03	2800	
H1-13	ຸ ບ	7.2	80.3	47.81	80.3	0.10	2000	
н1-16	Ç	72	72.1	47.71	72.1	0.45	1400	
н2-6	0،	72	130.7	41.67	130.7	0.18	2500	
H2-15	00	72	5*46	43.54	97.5	0.35	1700	
Avg.			106.5	44.50	106.5	0.22	2080	
Std.Dev.			33.8	3.07	33.8	0.17	5.70	
H1-1	00	260	96.5	44.90	96.5	0.24	1960	gage failed
H1-12	00	260	167.3	47.81	167.3	0.47	3100	
H1-15	00	260	120.2	47.99	120.2	0.27	2700	
н2-5	0,0	260	137.4	53.76	137.4	0.34	2500	
н2-10	e C	260	146.0	47.62	146,0	0.27	2800	
Avg.			133.5	48.42	133.5	0.32	2780	excludes H1-1
Std.Dev.			26.7	3.25	26.7	0.09	250	
H1-2	00	350	145.5	46.39	145.5	0.25	2800	
н1-7	0.0	350	140.3	47.71	140.3	0.40	2800	
H2-1	0.0	350	130.0	46.30	130.0	0.30	2700	
н2-9	00	350	165.0	55.44	165.0	0.29	3200	
H2-11	0.0	350	94.3	47.62	94.3	0.27	1800	
Avg.			135.0	48.69	135.0	0.30	2660	
Std.Dev.			32	3.83	26.1	0.06	520	

Test:	Tension			Mate	Material: HyE	2034D		
		Test	Ultimate		Stress at		Ultimate	
Spec. No.	Fiber Orien.	Temp.	Strength (ksi)	Modulus (10 ⁶ psi)	Prop.Lim. (ksi)	Pois. Ratio	Strain (pin/in)	Remarks
H3-3	• 06	-67	2.34	0.86	2.34	B	2400	
H3-7	90.	-67	2.68	1.06	2.68	1	2600	
9-9H	• 06	67	1.56	66*0	1.56		1800	
H7~5	•06	-67	1.72	0.87	1.72		1,700	
H7-10	60ء	-67	2.64	0.82	2.64	1	2800	
Avg.			2.19	0.92	2.19	***	2260	
Std.Dev			0.52	0.10	0.52	1	490	
H3-1	900	72	1.81	0.84	1,81		2190	
H4-5	90.	72	2.29	0.88	2.29	-	2500	
H7-3	•06	72	3.86	0.86	1.86	¥ Y	2100	
H67	900	72	2.34	0.84	2.34	1	2800	
H4-9	900	72	2.06	0.92	2.06	***************************************	2300	
Avg.			2.07		2.07		2360	
Std.Dev.			0.24	0.03	0.24	ma 644-64	300	
H3~6	90°	260	1.46	0.79	1.46	Live	1900	
H4-4	900	260	2.21	0.77	2.21	!	2900	
H7-2	90.	260	1.24	0.79	1 26		1630	
н7-8	60ء	260	1.94	0.79	1.94	ì	2500	
H7-9	90.6	260	1.80	0.81	7,80		2200	
Avg.			1.73	0.79	1.73		22.20	
Std.Dev.			0.38	0.01	0.38		510	
H4-2	90.6	350	1.92	0.91	1.10	- 1	2300	
H4-10	90°	350	0.87	1.12	0.81	1	1000	
H63	90.6	350	1.24	0.91	0.68		1500	
96-9	500	350	1.20	0.93	0.77		1500	
H7-7	90°	350	1.75	0.90	1.15	1	2300	
AVG.			1.40	0.96	0.00	1	1740	
Std.Dev.	-		0.43	0.10	0.21		560	

Test:	Tension			Mate	Material: HyE	2034D		
	ī	Test	Ultimate		Stress at		Ultimate	
Spec. No.	Fiber Orien.	Temp. (°F)	Strength (ksi)	Modulus (10 ⁶ psi)	Prop.Lim. (ksi)	Pois. Ratio	Strain (µin/in)	Remarks
H11-8	±45°	-67	11.67		4.17	0.77	2000	
H16-4	±45°	-67	12.24	3.50	3.92	0.71	4400	
H17-4	±45°	-67	11.62	3.50	4.65	0.73	4000	
H17-7	±45°	-67	12.45	3.43	4.69	0.71	2000	
H12-7	±45°	-67	11.34	3.70	3.90	0.80	4100	
Avo.			11.86	3.50	4.26	0.74	4500	
Std.Dev.			0.46	0.11	0.38	0.04	480	
H11-7	+450	72	13.02	2.84	4.03	0.91	5600	
н13-8	±45°	72	11.00	2.73	4.87	0.61	5100	
H15-4	±45°	72	10.78	2.71	4.51	1.00	6800	
H15-5	±45°	72	11.18	2.78	4.75	0.89	5500	
H15-7	¥45°	72	10.29	2.65	4.76	0.89	2900	
Avg.			10.85	2.74	4.58	0.87	5780	
Std.Dev.			0.35	0.07	0.34	0.12	640	
H10-2	±45°	260	9.35	2.44	3.05	0.75	6560	
H12-3	±45°	260	9.39	2.51	3,38	0.75	5380	
H13-1	±45°	260	9.75	2.50	2.50	0.88	0068	
H14-10	±45°	260	8.95	2.38	3,33	0.86	5660	
H17-6	+450	260	9.49	1.32	5.24	1.00	5460	
Avg.			9.39	2.23	3.50	0.85	6390	
Std.Dev.			0.29	0.51	1.03	0.11	1480	
H10-5	±45°	350	8.72	2.56	2,82	0.80	7100	
н11-9	±45°	350	8.42	2.22	2.44	1.06	7100	
H14-5	±45°	350	9,08	2.02	2.90	0.83	9280	
н18-2	±45°	350	9.13	2.79	3.51	1.04	7100	
H19-4	±45°	350	8.44	2.45	3.06	1.10	7800	
Avg.			8.76	2.41	2.95	96.0	7680	
Std.Dev.			0.34	0.30	0.39	0.14	950	

Test:	Tension			Mate	Material: une coode	0.00 Am		
			•	4 - 5 - 5 - 5	j ;		7 7 7 8 8 8	
Spec.	Fiber	Test Temp.	Strength	Initial	Stress at Prop. Lim.	Pois.	Ultimate Strain	
No.		(°F)	(ksi)	(10 ⁶ psi)	(ksi)	Ratio	(uin/in)	Remarks
H20-10	0/±45/90	72	81.21	29.67	62.31	*	2700	*All 90° strain measure-
H21-5	0/445/90	72	80.80	30.77	80.80	*	2600	
H22-4	0/+45/90	72	68.37	27.61	61,06	*	2450	recorder erroravg.
H25-2	0/±45/90	72	83,03	27.44	65.85	*	3280	value from extra
н33-10	0/445/90	72	65.70	26.58	65.70	*	0097	specimen tested later.
Avg.			75.82	28.41	67.14	0.42	2730	
Std.Dev.			8.12	1.74	7.92		320	
H21-8	0/±45/90	260	82.73	28.59	82.73	0.35	3000	
H22-1	0/±45/90	260	81.39	26.16	81.39	0.40	2800	
H22-6	0/±45/90°	260	80.36	25.64	80.36	0.45		gage failed
H25-1	0/±45/90°	260	88.17	26.71	88.17	0.44	en en	gage failed
H25-3	0/±45/90	260	86,27	26,16	86.27	0.36	3500	
AVG.			83.78	26.65	83.7B	0.40	3100	
Std.Dev.			3.32	1.15	3.32	0.04	360	
H22-2	0/145/90	350	90.84	28.20	90.84	0.46	3000	
н23-3	0/±45/90°	350	89.90	33.36	89.90	0.42	2700	
H23-4	0/145/90	350	75.87	22.35	75.87	0.27	2500	
H27-4	0/+45/90	350	85.86	27.39	85.86	0.39	2800	
н33-1	0/+45/90°	350	71.43	28.57	71.43	0.38	2600	
Avg.			82.78	27,98	82.78	0.38	2720	
Std.Dev.			8.65	3.92	8.69	0.07	190	
H20-4	0/±45/90	72	67.14					Based on net cross-
H20-9	0/±45/90	72	66.22					sectional area. Speci-
н21-6	0/445/90	72	61.20					mens had a 0.1935 inch
	0/+45/90	72	65.23					diameter hole in center
н26-2	0/±45/90°	72	63.80					of gage section.
Avg.			64.72					
std. Dev.			2.33					

Test:	Tension			Mate	Material: T30	T300/W3/8A		
		Test	Ultimate		Stress at		Ultimate	
Spec.	Fiber	Temp.	Strength	g -	Prop.Lim.	Pois.	Strain	0 2 3 0 0
	Orien.	(*F)	(KSI)		(YST)	KALTO	(117/117)	Remarks
16-1	00	-67	172.4	19,31	172.4	0.33	6,800	
116-5	00	-67	238.3	20,12	238.3	0.29	11,040	And the first transfer the section of the section o
íı	00	-67		2	240.8	0.29	17,200	
6-	00	-67	210.0	19.53	210.0	•	10,300	
117-17	0	-67	250.0	20.90	250.0		11,300	
Avg.			222.3	20.03	222.3	0.31	10,130	
Std.Dev			31.7	0.63	31.7	0.02	1,900	
6-7	00	72	189.7	19.58	189.7	0.29	6,060	
16-8	00	7.2		20.24	238.4	0,26	8,960	
1	00	72	250.6	19.71	250.6	0.32		
117-5	00	72	224.1	20.66	224.1		11,000	
117-14	00	72	248.4	20,32	248.4	. •1	11,720	
Avg.			230.2	20.10	230.2	0.30	١ ١	
Std.Dev	•		25.0	0.45	25.0	0.03	1,400	
16-2	ეტ	350	183.9	21,73	183.9	0.31	10.440	
116-4	၁၀	350	213.0	21.00	213.0	0.34	10.000	
6-911	6 0	350	189.5	20.95		0.29	8,400	
	00	350	224.7	24.51	224.7	0.37	9,800	
117-8	0 0	350	239.4	22.50	239.4	0.36	10,200	
Avg.			210.1	22.14	210.1	0.33	9,770	
Std.Dev	•		23.4	1.47	23.4	0.03	800	
116-3	0م	450	213.4	19.37	213.4	0.29	10,360	
116-6	0 0	450	200.8	18,90	200.8	0.30	11.400	
17-1	00	450	208.2	18.09	208.2	0.36	11.340	
17-12	00	450	223.8	20.04		1	•	
117-16	0.0	450	240.3	19.47	•	0.29	11,700	
Avg.			217.3	18.77		• 1	11,180	
S+0 Dev			15 2	CO .	r ur	* C	- CL4	

Spec. Fiber Test Ultima No. Orien. (°F) (ksignal I18-5 90° -67 6.67 I18-8 90° -67 6.67 I19-1 90° -67 5.96 I20-4 90° -67 5.96 I21-8 90° -67 5.96 Rvg. -67 5.96 11 I15-5 90° 72 4.74 I19-8 90° 72 4.96 I19-9 90° 72 4.96 I19-7 90° 72 4.96 I19-8 90° 72 4.96 I19-9 90° 72 4.96 I19-9 90° 72 4.96 I19-9 90° 72 4.96 I19-9 90° 350 4.08 I19-5 90° 350 4.08 I19-7 90° 350 4.08 I19-7 90		Mate	Material: T30	T300/V378A		
No. Orien. (°F) -5 90° -67 -8 90° -67 -4 90° -67 -8 90° -67 -9 90° -67 -7 90° 72 -7 90° 72 -4 90° 72 -7 90° 72 -8 90° 72 -9 90° 72 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450			Stress at		Ultimate	
40. Orien. (°F) -5 90° -67 -8 90° -67 -4 90° -67 -8 90° -67 -9 90° -67 -7 90° 72 -9 90° 72 -1 90° 72 -1 90° 72 -2 90° 72 -2 90° 72 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450	<u>.</u>		Prop. Lim.	Pois.	Strain	•
-5 90° -67 -8 90° -67 -4 90° -67 -8 90° -67 -6 90° -67 -7 90° 72 -7 90° 72 -8 90° 72 -7 90° 350 -9 90° 350 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450	_	(10°psi)	(ksi)	Ratio	(h in/in)	Remarks
-8 90° -67 -1 90° -67 -8 90° -67 -8 90° -67 -67 -9 90° -67 -7 90° 72 -7 90° 72 -4 90° 72 -7 90° 72 -8 90° 72 -9 90° 72 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450	7 6.67	1.39	6.67		4,875	
-1 90° -67 -8 90° -67 -8 90° -67 -9 90° -57 -2 90° 72 -4 90° 72 -4 90° 72 -4 90° 72 -4 90° 72 -1 90° 350 -9 90° 350 -9 90° 350 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450	7 6.69	1.41	69.9	1	4.745	
-4 90° -67 -8 90° -67 -9 90° -67 -5 90° 72 -4 90° 72 -4 90° 72 -4 90° 72 -8 90° 350 -9 90° 350 -9 90° 350 -9 90° 350 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450		1,41	4,68	-	3,365	
-8 90° -67 -9 90° 72 -9 90° 72 -9 90° 72 -4 90° 72 -1 90° 350 -3 90° 350 -9 90° 350 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450		1.41	5.12		4,515	
. bev. -5 90° 72 -7 90° 72 -4 90° 72 -7 90° 72 -7 90° 350 -8 90° 350 -9 90° 350 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450 -1 90° 450		1.39	5.96	1	4,225	
5 90° 72 90° 72 90° 72 1 90° 72 1 90° 350 90° 350 90° 350 90° 350 90° 350 1 90° 450 10 90° 450 1 90° 450 1 90° 450	5.82		5.82		4,345	
90° 72 90° 72 90° 72 1 90° 72 1 90° 350 90° 350 90° 350 90° 350 1 90° 450 1 90° 450 1 90° 450 1 90° 450	0.91	0.01	0.91		009	
5 90° 72 90° 72 90° 72 1 90° 72 1 90° 350 8 90° 350 9 90° 350 9 90° 350 1 90° 450 1 90° 450 1 90° 450 1 90° 450						
2 90° 72 3 90° 72 1 90° 72 1 90° 72 3 90° 350 3 90° 350 5 90° 350 6 90° 350 10 90° 450 11 90° 450 12 90° 450 13 90° 450 1450 1 90° 450	2	1.27	4.74	* **	3,735	
90° 72 90° 72 1 90° 72 90° 350 90° 350 90° 350 90° 350 9 90° 350 10 90° 450 10 90° 450 11 90° 450 12 90° 450	2	1.29	4.18	**	4,420	
90° 72 1 90° 72 3 90° 350 3 90° 350 5 90° 350 9 90° 350 10 90° 450 10 90° 450 1 90° 450 1 90° 450	2	1.35	2.44	1	4,685	
3 90° 72 3 90° 350 3 90° 350 3 90° 350 9 90° 350 10 90° 450 10 90° 450 11 90° 450 12 90° 450	2	1.32	3.56	1	3,760	
3 90° 350 3 90° 350 3 90° 350 1 90° 350 1 90° 450 1 90° 450 1 90° 450 1 90° 450	2	1.30	2.85	1	4,115	
3 90° 350 3 90° 350 3 90° 350 90° 350 10 90° 350 10 90° 450 10 90° 450 10 90° 450 10 90° 450	5.37	1:31	3.55		0 †I′ ‡	
3 90° 350 3 90° 350 3 90° 350 9 90° 350 10 90° 450 10 90° 450 10 90° 450 10 90° 450 10 90° 450	0.55	0.03	0.94		0.1.4	
3 90° 350 3 90° 350 90° 350 1 90° 350 10 90° 450 1 90° 450 1 90° 450 1 90° 450						
3 90° 350 90° 350 1 90° 350 10 90° 450 1 90° 450 1 90° 450 1 90° 450 1 90° 450	0	1.04	3,45	1	4,275	
5 90° 350 1 90° 350 350 5 90° 450 7 90° 450 1 90° 450 1 90° 450 1 90° 450		1.04	3.81	1	3,950	
9 90° 350 1 90° 350 10 90° 450 1 90° 450 1 90° 450 1 90° 450		1.08	4.09	1 1 1	4,700	
10 90° 350 10 90° 450 10 90° 450 10 90° 450 10 90° 450		1.09	3.16	111	3,650	
Dev. 10 900 450 7 900 450 1 900 450 10 900 450		1.12	3.62	1	4,085	
10 900 450 7 900 450 9 900 450 1 900 450 10 900 450	4.84	1.07	3.63		4,130	
10 90° 450 7 90° 450 9 90° 450 10 90° 450	0.38	0.03	0.35		390	
10 900 450 7 900 450 1 900 450 10 900 450						
90° 450 90° 450 1 90° 450		1.03	2.08	us 41 s	3,365	
-9 90° 450 -1; 90° 450 -10 90° 450	.0 3.7I	96.0	2.04	-	3,910	
-1: 90° 450 -10 90° 450		1.00	2.17		4,640	
-10 90 ⁰ 450		66.0	3.44	i	4,825	
•		1.01	3.03	1	4,705	
	4.21	1.00	2.55		4,290	
. Devj.	0.57	-0.02	0.64		630	

Test:	Tension			Mate	Material: T30	T300/V378A		
		Test	Ultimate	Initial	Stress at		Ultimate	
Spec. No.	Fiber Orien.	Temp.	Strength (ksi)	Modulus (10 ⁶ psi)	Prop.Lim. (ksi)	Pois. Ratio	Strain (u in/in)	Remarks
14-6	±45°	-67	22.38	3.17	9.27	0.73	9,620	
15-10	±450	-67	23.12	3.35	8.63	0.71	8,800	
16-8	+450	-67	20.95	2.90	8.81	0.61	8,280	
19-1	±450	-67	20.84	3.05		0.71	10,300	
110-5	±450	-67	20.33	3.16		0.73	8,100	AND THE PROPERTY OF THE PROPER
Avg.			21.52	3.13	•	0.70	9,020	And the second state of th
Std. Dev			1.17	0.16	0.83	C.05	930	
I4-3	±450	72	19.18	2.97	7.35	09.0	8,000	
19-9	±450	72	22.14	2.98	6.19	0.63	4,500	*
110-7	±450	72	21.42	2.91	6.29	0.53	12,000	
111-5	±450	72	21.96	2.97	6.42	0.63	008'6	*
1222-1	±45°	72	21.76	2.98	5.49	0.58	12,200	
Avg.			21.29	2.96	6.35	0.59	12,100	
Std.Der			1.21	0.03	0.67	0.04		
18-6	±450	350	16.26	2.39	5.36	0.93	18,200	Anne de la Companya de La Compa
19-8	±450	350	16.17	2.64	4.04	1.08	23,600	And the second s
110-10	±450	350	14.96	2.41	4.83	0.95	39,400	
111-4	±450	350	16.77	2.58	3.95	1.03	008.9	*
122-2	±450	350	16.43	2.65	4.29		10,200	*
AVG.			-4	2.54	4.49	•	27,070	
Std. Dev	,		•1	0.13	0.59	0.07	11,020	
15-1	±45°	450	14.46	2.14	3,98	0.81	20,000	
18-7	z450	450	14.92	2.32	3.06		20,400	
19-6I	1450	450	15.02	2.18	2.45	0.87	20,600	
110-9	∓45°	450	14.88	2.02	4.26	0.81	20,200	
111-8	±450	450	15.41	2.16	3.56		20,400	
Avg.			14.94	2.16	3.46	0.82	20,320	
Std.Dev	-		0.34	0.11	0.73		230	

*Not included in ult. strain avg. and std. dev.; strain gage failed prior to end of test

Test:	Tension			Mate	Material: V378	*		
		Test	Ultimate		Stress at		Ultimate	
Spec.	Fiber	Temp.	Strength	Modulus	Prop. Lim.	Pois.	Strain	•
Š	Orien.	(*F)	(k31)		(k 31)	Ratio	(u in/in)	Remarks
I28-4	0/445/90		109.7	13.33	109.7	0.57	10,750	
129-4	0/145/90	72	102.6	12.26	•	0.58	10,200	
137-3	! ~		130.4	14.83	130.4	0.53	10,600	
139-3	0/145/90	72	125.4	14.80	125.4	0.63	10,500	
140-3	0/145/90	72	130.4	14.58	130.4	0.65	10,900	
Avg.			119.7	13.96	1.6.1	0.59	10,590	
Std.Dev			12.8	1.13	12.8	0.05	270	
112-3	0/145/90	350	112.9	15.39	112.9	1	7,750	
113-3	/42/	350	107.7	9.83	107.7	99.0	10,250	
125-3	0/1:45/90		6.66	13.43	6.66	0.53	8,750	
I30-3	45/		90.3	12.54	90.3	0.58	000'6	
140-2	0/:45/90	350	9.611	15.89	119.6	0.69	9,350	
Avg.			106.1	13.41	106.1	0.62	9.020	
Std.Dev				2.43		0.07	910	
\sim 1	0/445/90	450	88.9	12.43	88.9	0.34	2,000	
\sim	0/#34/90		102.4	13.68	102.4	0.57	9,000	
	0/445/90		111.6	12.14	111.6	0.63	10,650	
	0/445/90	450	115.3	13.86	115.3	0.50	10,000	
	0/145/90		119.2	13.62	119.2	0.56	10,250	
Avg.			107.5	13,15	107.5	0.52	088'6	
Std.Dev	•		1.21	0.80	12.1	0.11	1,460	
							27	
I12-1	0/1245/90	72	86.4				- 1	These specimens had a
		72	79.9		**			100
-2			83.0		1		‡ ‡	hole in the center of
135-1	0/145/90	7	'n.			1	i i	section.
138-1	0/145/90	7	112.5					Strength is based on
Avg.			93.1					net cross-sectional
Std.Dev	٠		14.2					area.
			والشارات والمساولات وا					

1 4 4 5				16. ±	ı			
rest	norsuar		-	שמ רב	Maretial HyE	HVE 1076.J		
		Test	Ultimate	Initial	Stress at		Ultimate	
Spec.	Fiber	Temp.	Strength		Prop. Lim.	Pois.	Strain	
No.	Orien.	(°F)	(ksi)	(100bsi)	(ksi)	Ratio	(hin/in)	Remarks
318-3	00	-67	198.4	20.97	198.4	0.33	0006	
318-11	00	-67	197.0	20.12	197.0	0.30	8900	
318-17	0.	-67	213.5	20.68	213.5	0.29	4500	gage failed
719-4	0,0	-67	202.6	19.64	202.6	0.34	8500	
J19-8	0.	-67	172.5	20.83	172.5	0.33	8000	
Avg.			196.8	20.45	196.8	0.32	8600	excludes J18-17
Std.Dev.			15.1	0.56	15.1	0.02	450	
J18-1	٥٥	72	8.061	18.37	190.8	0.35	10100	
J18-5	0 ه	72	194.4	20.03	194.4	C.31	10700	
J18-15	<i>"</i> 0	72	219.4	20.43	219.4	0.31	10000	
J19-1	0.0	72	214.5	18.15	214.5	0.23	10800	
J19-6	0.0	7.2	216.4	19.49	216.4	0.33	10500	
Avg.			207.1	19.29	207.1	0.32	10420	
Std.Dev.			13.4	1.00	13.4	0.02	360	
718-4	٥.	260	211.5	22.53	211.5	0.31	9500	
J18-8	0°	260	254.7	21.19	254.7	0.30	10200	
318-12	0.	260	224.6	21.64	224.6	0.36	9500	
J19-5	0.	260	235.2	22.93	235.2	0.29	10500	
J19-7	0.	260	235.8	22.61	235.8	0.30	0086	
Avg.			232.3	22.38	232.3	0.31	0066	
Std.Dev.			15.9	0.49	15.9	0.03	440	
119-2	.0	350	228.9	22.28	228.9	0.33	5600	gage failed
119-3	٥.	350	227.4	20.16	227.4	0.33	10700	
J18-2	००	350	242.2	23.94	242.2	0.39	0086	
318-10	Çio	350	224.9	21.71	224.9	0.37	0096	
318-16	00	350	218.7	22.49	218.7	0.32	0096	
Avg			228.4	22.12	228.4	0.35	9930	excludes J19-2
Std.Dev.			8.6	1.37	8.6	0,03	530	

Test:	Tension			Mate	Material: HyE	10763		
		Test	Ultimate		Stress at		Ultimate	
Spec.	Fiber Orien.	Temp. (°F)	Strength (ksi)	Modulus $(10^6 psi)$	Prop.Lim. (ksi)	Pols. Ratio	Strain (µin/in)	Remarks
J26-6	906	-67	6.29	1.88	6.29		3100	
327-3	006	-67	3,23	1.78	3.23	3 2	1900	
J28-3	• 06	-67	3.96	1.49	3.96	i i	2500	
329-2	。 06	19-	5,31	1.68	3.11	1	3300	
J29-4	06ء	<i>-</i> 67	4.85	1.60	4.85	a	3000	
Avg.			4.73	1,69	4.29	1	2760	
Std.Dev.			1.19	0.15	1.32	an. an. an.	560	
326-1	, 0 6	72	6,13	1.37	6.13	1	3900	
J26-5	06،	7.2	4.93	1.39	4.93	1	3200	
J28-1	, 06	72	6.17	1.34	6.17	1	4300	
J29-1	0 06	72	6.52	1.33	6.52	j	4600	
J30-2	•06	72	4.53	1.28	4.53		3500	
Avg.			5.66	1,34	5,66		3900	
Std.Dev.			0.87	0.04	0.87	3	570	
J26-8	°06	260	3.64	1.55	3.64		2100	
J27-8	90°	260	4.68	1.39	4.68	1	3400	
J28-9	• 0 6	260	4.11	1.40	4.11	1 1	2800	
J29-8	90.	260	3.76	1.37	3,76	1	2600	
J30-7	,06	260	2.87	1.16	2,87	•	2300	
Avg.			3.81	1.37	3.81	1	2640	
Std.Dev.			0.66	0.14	99.0	1	500	
J26-3	06،	350	3.59	1.43	3,59	1	2300	
327-2	°06	350	3.59	1.29	3.59	4	2800	
J28-5	06،	350	3.67	1.25	3,67	1	2800	
J29-5	•06	350	3.83	1.27	3.83	1.	3000	
J30-3	06،	350	2.67	1.25	2.67		2200	The state of the s
Avg.			3,47	1.30	3.47	-	2620	ender betreite
Std.Dev.			0.46	0.08	0.46		350	esiaya da Ciring massi, miyang — ta paragai, nga girang ang massanan na paggayang nga girang nganggang ngang n

The second secon

Test:	Tension			Mate	Material: FYE	1076.1	and the state of t	
		Test	Ultimate				Ultimate	
Spec.	Fiber	Temp.	Strength	Modulus	Prop.Lim.	Pois.	Strain	0
	****			7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	(TE3)	27.50	(117 /1177)	O V T BILLION
J4-3	± 45°	-67	26,77	3,25	11.02	0.64	10700	
J6-2	± 45°	-67	30,92	2.93	10,00	0.68	15300	
.18-2	±450	-67	26.40	3.17	16.53	0.49	9400	
J10-2	+ 45°	-67	26,68	3.19	18.31	0.57	10200	
J11-3	+450	-67	26.68	3.29	12.19	0.48	10000	
Avg.			27.49	3.16	13.61	0.57.	11120	
Std.Dev.			1.92	0.14	3.62	0.09.	2380	
33-2	± 45 °	72	22.00	2.96	6.83	0.62	10300	gage failed
J5-6	±45°	72	22.18	3.16	6.08	0.68	13100	
J8-2	±45°	72	22,17	3.17	4.19	0.71	6200	gade failed
J11-2	±45°	72	22.73	3.00	9.25	0.65	11200	
312-2	±45°	72	22.33	3.09	5,74	0.67	10700	
Avg.			22.28	3.08	6.42	0.67	11670	omits J3-2 & J8-2
Std.Dev.			0.28	0,10	1.85	0.03	1270	
J3-1	±45°	260	15.55	2,92	4.60	69.0	10400	
35-1	±45°	260	15,81	3,11	3,58	0.71	14400	
J7-1	±45°	260	17.44	3.04	4,86	0.66	16200	
J9-1	±45°	260	16.90	3.41	4.64	0.79	20000	
1717-1	±45°	260	16.77	2.99	4.13	0 7"	33400	
AVG.			16.49	3.09	4.36	0.73	18880	
Std.Dev.			0.79	0.19	0.51	0.05	9820	
J3-6	±45°	350	16.72	2.65	3.99	0.67	20000	gage failed
J4-2	±45°	350	16.37	2.84	5.19	0.74	32000	
J7-6	±45°	350	13.71	2.42	4.24	0.77	36800	
J9-7	±45°	350	15.33	2.81	3.78	0.70	8000	gade failed
J11-8	±45°	350	15.85	2.68	3.87	0.70	16000	gade failed
Avg.			16.60	2.68	4.21	0.71	34400	only J4-2 & J7-6 included
Std.Dev.			1.29	0.17	0.57	0.04		
							The same of the sa	**************************************

		Test	Ultimate	Initial	Stress at		Ultimate	
Spec.	Fiber Orien.	Temp.	Strength (ksi)	Modulus (106psi)	Prop.Lim. (ksi)	Pois. Ratio	Strain (uin/in)	Remarks
J15-6	06/547/0	72	108.9	10.49	108.9	0.37	10200	
317-5	06/514/0	72	115.0	11.00	115.0	0.36	10200	
321-6	0/145/90	72	121.4	11.64	121.4	0.36	11000	
323-4	0/445/90	72	110.8	11.17	110.8	0.39	10300	
J25-5	06/577/0	72	128.1	11.66	128.1	0.37	11400	
Avg.			116.8	11.19	116.8	0.37	16620	
Std.Dev.	-		7.9	0.49	6.7	0.01	550	
713-6	06/447/0	260	112.2	12.46	112.2	0.45	8300	
314-7	0/#45/900	260	127.0	11.03	127.0	0.37	10300	
317-4	0/±45/90	260	121.1	12,36	121.1	0.39	10400	
J21-8	0/±45/90	260	123.9	12.64	123.9	0.42	9900	
323-5	0/445/90	260	116.2	12.50	116.2	0.39	. 9400	
Avg.			120.1	12.20	120.1	0.40	9780	
Std.Dev.			5.9	0.66	5.9	0.03	630	
314-6	0/±45/90	350	109.3	10.87	109.3	0.38	10500	
316-6	0/445/90	350	114.2	11.24	114.2	0.29	0066	
J20-6	0/445/909	350	119.8	12.17	119.8	0.37	9500	
J22-6	0/±45/90	350	126.3	12.83	126.3	0.37	7600	qage failed
J24-4	0/445/90	350	121 1	12,36	121.1	0.38	9700	
Avg.			118.1	11.89	118.1	0.36	0066	omits 122-6
Std.Dev.			9.9	0.81	9.9	0.04	430	omits J22-6
313-2	0 /4 45 /900	7.2	86.8					These specimens had a
J14-2	0/145/90	72	93.4					5 inch diameter
J16-2	0/445/90	72	99.1					hole in the center of
	0/±45/90	72	84.5					sec
J25-1	0445/90	72	78.6					is based on net cross-
Avg.			88.5					sectional area.
Std.Dev.			8.0				,	

Triber Temp. Strength Modulus Prop.Lim. Pois. Strain Orien. (*F) (ksi) Modulus Prop.Lim. Pois. Strain (infinity) (ksi) (infinity)	Test:	Tension			Mate	Material: G-	G-160/6535-1		
Fiber Temp. Strength (106 psi) Modulus (ksi) Ratio (uin/in) 0rien. (*F) (*isi) (106 psi) (*isi) (*isi) 0° -67 213.8 18.39 124.8 0.35 11500 0° -67 154.8 17.90 154.8 0.37 2250 0° -67 158.9 19.23 168.8 0.29 2850 0° -67 168.9 19.23 168.3 0.21 2800 0° -67 148.3 18.39 148.3 0.21 3800 0° -67 140.3 18.99 172.4 0.04 1410 0° -67 120.6 18.99 174.0 0.31 9100 0° 72 170.6 18.99 174.0 0.31 9100 0° 72 180.0 19.05 180.0 0.31 8500 0° 72 180.0 180.0 0.32 180.0 0° <th></th> <th></th> <th>To a +</th> <th></th> <th>Initial</th> <th>Stress at</th> <th></th> <th>Ultimate</th> <th></th>			To a +		Initial	Stress at		Ultimate	
Orien. (***) (***st) (Spec.	Fiber	Temp.	Strength	Modulus	Prop.Lim.	Pois. Ratio	Strain (uin/in)	Remarks
0° -67 213.8 16.39 213.8 0.35 1.5 0° -67 154.8 17.80 154.8 0.29 0.29 0° -67 176.4 19.23 168.8 0.28 0.29 0° -67 148.3 19.23 168.8 0.21 0.28 0° -67 148.3 18.39 149.3 0.21 0.28 0° -67 148.3 18.49 172.4 0.31 0.21 0° 72 174.0 18.99 174.0 0.31 0.31 0° 72 164.3 17.64 164.3 0.31 0.31 0° 72 164.3 17.64 164.3 0.31 0° 72 148.4 18.59 148.4 0.31 0° 72 148.4 18.54 164.3 0.33 0° 72 148.4 18.50 0.33 0° 260 166.0 2	No.	Orien.	(3.)	(KST)	1700 071			0011	
0° -67 154.8 17.80 154.8 0.29 0° -67 176.4 18.65 176.4 0.37 0° -67 168.8 18.39 146.4 0.28 0° -67 148.3 18.39 142.4 0.31 0° -67 172.4 16.39 172.4 0.31 0° -67 172.4 16.49 172.4 0.03 0° 72 174.0 18.94 170.6 0.31 0° 72 174.0 18.94 170.6 0.31 0° 72 174.0 18.94 170.0 0.31 0° 72 164.3 174.0 0.31 0° 72 164.3 174.0 0.31 0° 72 148.4 18.96 148.4 0.31 0° 72 148.4 18.96 148.4 0.31 0° 260 166.8 20.31 166.0 0.3	K12-4	0	-67	213.8	18.39	213.8	0.35	00577	nationistikaisellisis eliktisississa propherioristasistasistasistasistasistasistasista
0° -67 176.4 18.65 176.4 0.37 0° -67 168.8 19.23 168.8 0.28 0° -67 148.3 18.43 148.3 0.21 0° -67 172.4 18.43 172.4 0.31 0° 72 170.6 18.94 170.6 0.31 0° 72 170.6 18.99 174.0 0.31 0° 72 164.3 17.64 164.3 0.31 0° 72 180.0 18.99 148.4 0.33 0° 72 164.3 17.64 164.3 0.34 0° 72 140.0 18.99 148.4 0.33 0° 72 140.0 18.99 148.4 0.33 0° 72 142.5 18.99 148.4 0.33 0° 72 148.4 16.4 0.33 0° 260 166.0 20.51 166.0<	K12-8	00	-67	154.8	17.80	154.8	0.29	8420	
0° -67 168.8 19.23 168.8 0.28 0° -67 148.3 18.39 148.3 0.27 0° -67 148.3 172.4 0.031 0° 72 170.6 18.94 170.6 0.31 0° 72 176.0 18.94 170.6 0.31 0° 72 140.0 18.09 174.0 0.31 0° 72 140.0 18.09 174.0 0.31 0° 72 140.0 18.09 174.0 0.31 0° 72 140.0 18.09 174.0 0.31 0° 72 140.0 18.06 0.33 0.33 0° 72 140.0 18.99 148.4 0.33 0° 260 166.0 20.37 166.8 0.38 0° 260 166.0 20.37 166.8 0.36 0° 260 166.0 20.31 162.	K13-1	0.0	-67	176.4	18.65	176.4	0.37	9250	
0° -67 148.3 18.39 148.3 0.27 0° 72 172.4 16.49 172.4 0.31 0° 72 170.6 18.94 170.6 0.31 0° 72 174.0 18.09 174.0 0.31 0° 72 164.3 17.64 164.3 0.31 0° 72 164.3 17.64 164.3 0.31 0° 72 164.3 17.64 164.3 0.31 0° 72 148.4 18.09 0.31 0.33 0° 72 148.4 18.96 148.4 0.33 0° 72 148.4 18.54 167.5 0.03 0° 260 161.7 20.51 156.0 0.33 0° 260 166.8 20.37 166.8 0.38 0° 260 166.8 20.37 166.8 0.36 0° 260 166.8 20.37<	K13-8	00	-67	168.8	19.23	168.8	0.28	8900	
0° 172.4 18.49 172.4 0.31 0° 25.7 0.52 25.7 0.04 0° 72 170.6 18.94 170.6 0.31 0° 72 174.0 18.09 174.0 0.31 0° 72 164.3 19.05 180.0 0.34 0° 72 164.3 19.05 180.0 0.34 0° 72 164.3 19.05 180.0 0.34 0° 72 148.4 18.93 148.4 0.31 0° 72 164.8 18.54 167.5 0.01 0° 72 148.4 12.1 0.01 0° 260 166.0 22.02 166.8 0.35 0° 260 166.0 22.02 166.8 0.35 0° 260 166.0 22.02 166.0 0.35 0° 260 166.0 22.02 166.0 0.35 <tr< td=""><td>V13-5</td><td>00</td><td>-67</td><td>148.3</td><td>18.39</td><td>148.3</td><td>0.27</td><td>7800</td><td>me eng. of the included the first of the first of the included the included the spirit of the included the in</td></tr<>	V13-5	00	-67	148.3	18.39	148.3	0.27	7800	me eng. of the included the first of the first of the included the included the spirit of the included the in
0° 72 170.6 18.94 170.6 0.31 0° 72 170.6 18.94 170.6 0.31 0° 72 174.0 18.09 174.0 0.31 0° 72 164.3 17.64 164.3 0.31 0° 72 164.3 17.64 164.3 0.31 0° 72 148.4 18.09 174.0 0.34 0° 72 148.4 18.93 148.4 0.33 0° 72 148.4 18.93 148.4 0.33 0° 260 167.5 18.54 167.5 0.01 0° 260 166.8 20.37 166.8 0.38 0° 260 166.8 20.37 166.8 0.38 0° 260 166.8 20.37 166.8 0.38 0° 260 168.6 20.37 168.6 0.36 0° 260 168.6 21.1	0.10-0			172.4	18.49	172.4	0.31	9180	
0° 72 170.6 18.94 170.6 0.31 0° 72 174.0 18.09 174.0 0.31 0° 72 164.3 17.64 164.3 0.31 0° 72 164.3 17.64 164.3 0.34 0° 72 180.0 19.05 180.0 0.34 0° 72 148.4 18.93 148.4 0.33 0° 260 167.5 18.54 167.5 0.01 0° 260 166.8 20.51 156.0 0.38 0° 260 166.8 20.37 166.8 0.38 0° 260 166.8 20.37 166.8 0.38 0° 260 166.8 20.37 166.8 0.35 0° 260 166.8 20.37 166.8 0.35 0° 260 166.8 20.31 8.1 0.02 0° 260 169.6 21.1	. 5A4.			25.7	0.52	25.7	0.04	1410	
0° 72 170.6 18.94 170.6 0.31 0° 72 174.0 18.09 174.0 0.31 0° 72 164.3 17.64 164.3 0.31 0° 72 180.0 19.05 180.0 0.34 0° 72 180.0 19.05 180.0 0.34 0° 72 148.4 18.93 148.4 0.33 0° 72 148.4 18.93 148.4 0.33 0° 72 148.4 16.3 0.33 0° 260 167.5 18.93 148.4 0.33 0° 260 166.0 22.02 166.8 0.35 0.35 0° 260 166.0 21.39 150.0 0.36 0.35 0° 260 166.0 21.39 150.0 0.36 0.35 0° 260 150.0 21.39 150.0 0.36 0° 350 <td>2.4.00</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>THE RESERVE OF THE PROPERTY OF</td>	2.4.00								THE RESERVE OF THE PROPERTY OF
0° 72 174.0 18.09 174.0 0.31 0° 72 164.3 17.64 164.3 0.31 0° 72 180.0 19.05 180.0 0.34 0° 72 148.4 18.93 148.4 0.33 0° 72 148.4 18.93 148.4 0.33 0° 72 148.4 18.34 167.5 0.33 0° 260 161.7 20.51 150.0 0.33 0° 260 166.0 22.02 166.8 20.35 0° 260 166.8 20.37 166.8 0.36 0° 260 166.0 21.26 166.0 0.36 0° 260 150.0 21.39 150.0 0.36 0° 260 150.0 21.39 150.0 0.36 0° 350 190.0 19.74 170.7 0.22 0° 350 176.7 1	v12-2	00	72	170.6	18.94	170.6	0.31	8500	
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0° 72 180.0 19.05 180.0 0.34 0° 72 148.4 18.98 148.4 0.33 0° 72 148.4 18.98 148.4 0.33 0° 167.5 18.54 167.5 0.32 12.1 12.1 0.01 0.01 0° 260 166.8 22.02 166.8 0.36 0° 260 166.8 20.37 166.8 0.36 0° 260 166.8 20.37 166.8 0.36 0° 260 166.8 21.26 166.8 0.36 0° 260 166.8 21.26 166.8 0.36 0° 260 150.0 21.39 150.0 0.36 0° 350 190.0 19.74 170.7 0.02 0° 350 151.9 19.59 148.4 0.30 0° 350 176.7 19.79 176.7 0.08 <td>V13-4</td> <td>٥٥</td> <td>72</td> <td>164.3</td> <td>17.64</td> <td>1.64.3</td> <td>0.31</td> <td>8640</td> <td>. Description of the second of</td>	V13-4	٥٥	72	164.3	17.64	1.64.3	0.31	8640	. Description of the second of
0° 72 148.4 18.98 148.4 0.33 167.5 167.5 18.54 167.5 0.32 12.1 0.64 12.1 0.01 0° 260 161.7 20.51 156.0 0.36 0° 260 166.8 20.37 166.8 0.36 0° 260 166.8 20.37 166.8 0.36 0° 260 166.8 20.37 166.8 0.38 0° 260 166.8 20.37 168.6 0.38 0° 260 150.0 21.39 150.0 0.36 0° 260 150.0 21.39 150.0 0.36 0° 350 190.0 19.74 170.7 0.22 0° 350 194.2 19.79 148.4 0.36 0° 350 176.7 19.79 176.3 0.41 0° 350 143.9 166.7 0.07 0.08	K13-14	0.0	72	180.0	19.05	180.0	0.34	0006	
0° 167.5 18.54 167.5 0.32 0° 260 161.7 20.51 156.0 0.33 0° 260 166.0 22.02 166.0 0.36 0° 260 166.0 22.02 166.8 0.38 0° 260 166.9 20.37 166.8 0.38 0° 260 166.0 21.26 168.6 0.38 0° 260 150.0 21.39 150.0 0.38 0° 260 150.0 21.39 150.0 0.36 0° 350 190.0 19.74 170.7 0.22 0° 350 151.9 19.59 148.4 0.30 0° 350 151.9 19.59 148.4 0.36 0° 350 151.2 19.65.7 0.36 0° 350 143.9 21.27 0.36 0° 350 143.9 21.27 0.36 <	¥13-7	00	72	148.4	18.93	148.4	0.33	7400	
0° 260 161.7 20,51 156.0 0.33 0° 260 166.8 22.02 166.8 0.36 0° 260 166.8 22.02 166.8 0.36 0° 260 166.8 21.26 166.8 0.36 0° 260 166.8 21.36 166.8 0.36 0° 260 166.8 21.39 150.0 0.36 0° 260 162.6 21.11 161.5 0.36 0° 350 190.0 19.74 170.7 0.22 0° 350 194.2 19.59 148.4 0.30 0° 350 176.7 19.79 176.3 0.41 0° 350 143.9 21.27 143.9 0.41 0° 350 143.9 21.27 0.07 0.01 0° 350 171.3 0.07 0.01) CTV			167.5	18.54	167.5	0.32	8530	
0° 260 161.7 20.51 156.0 0.33 0° 260 166.8 22.02 166.8 0.36 0° 260 166.8 20.37 166.8 0.36 0° 260 166.8 21.26 168.6 0.35 0° 260 150.0 21.39 150.0 0.36 0° 350 190.0 19.74 170.7 0.22 0° 350 194.2 19.05 194.2 0.36 0° 350 176.7 19.79 176.3 0.31 0° 350 143.9 21.27 143.9 0.41 0° 350 171.3 19.89 166.7 0.31 0° 350 171.3 19.89 166.7 0.31	S+d. Dev.			12.1	n.64	12.1	0.0]	680	
0° 260 161.7 20,51 156.0 0.33 0° 260 166.0 22.02 166.8 0.36 0° 260 168.6 20.37 168.6 0.38 0° 260 168.6 21.26 168.6 0.35 0° 260 150.0 21.39 150.0 0.36 1 162.6 21.11 161.5 0.36 1 7.5 0.68 8.1 0.02 0° 350 190.0 19.74 170.7 0.30 0° 350 151.9 19.59 148.4 0.30 0° 350 154.2 19.59 148.4 0.36 0° 350 176.7 19.79 176.3 0.41 0° 350 176.7 19.79 166.7 0.31 0° 350 171.3 19.89 166.7 0.31 0° 350 171.2 0.07 0.31									
0° 260 166.0 22.02 166.0 0.36 0° 260 166.8 20.37 166.8 0.38 0° 260 168.6 21.26 168.6 0.35 0° 260 150.0 21.39 150.0 0.36 162.6 21.11 161.5 0.36 162.6 21.11 161.5 0.36 0° 350 190.0 19.74 170.7 0.22 0° 350 151.9 19.59 148.4 0.30 0° 350 151.9 19.59 148.4 0.30 0° 350 151.9 19.59 148.4 0.30 0° 350 176.7 19.79 176.3 0.36 0° 350 143.9 21.27 143.9 0.41 0° 350 143.9 21.27 0.30 0.31 0° 350 143.9 0.03 0.01 0.01	K12-1	0.0	260	161.7	20,51	156.0	0.33	9,000	
0° 260 166.8 20.37 166.8 0.38 0° 260 168.6 21.26 168.6 0.35 0° 260 150.0 21.39 150.0 0.38 . 260 150.6 21.11 161.5 0.36 . 7.5 0.68 8.1 0.02 . 7.5 0.68 8.1 0.02 . 350 190.0 19.74 170.7 0.30 . 350 151.9 19.59 148.4 0.30 . 350 176.7 19.79 176.3 0.36 . 350 176.7 19.79 176.3 0.36 . 350 143.9 21.27 143.9 0.41 . 350 143.9 21.27 0.31 0.31 . 350 143.9 0.07 0.01	V12-5	0	260	166.0	22.02	166.0	0.36	8400	
0° 260 168.6 21.26 168.6 0.35 0° 260 150.0 21.39 150.0 0.38 . 162.6 21.11 161.5 0.36 . 7.5 0.68 8.1 0.02 . 350 190.0 19.74 170.7 0.22 . 0° 350 151.9 19.59 148.4 0.30 . 0° 350 176.7 19.79 176.3 0.36 . 0° 350 143.9 21.27 143.9 0.41 . 0° 350 171.3 19.89 166.7 0.31	X13-3	0	260	166.8	20.37	166.8	0.38	7900	
0° 260 150.0 21.39 150.0 0.38 . 162.6 21.11 161.5 0.36 . 7.5 0.68 8.1 0.02 . 350 190.0 19.74 170.7 0.22 . 0° 350 151.9 19.59 148.4 0.30 . 0° 350 176.7 19.79 176.3 0.36 . 0° 350 143.9 21.27 143.9 0.41 . 0° 350 171.3 19.89 166.7 0.31	K13-10	00	260	169.6	21.26	168.6	0.35	0077	and the control of th
0° 162.6 21.11 161.5 0.36 7.5 0.68 8.1 0.02 0° 350 190.0 19.74 170.7 0.22 0° 350 151.9 19.59 148.4 0.30 0° 350 176.7 19.79 176.3 0.36 0° 350 176.7 19.79 176.3 0.36 0° 350 143.9 21.27 143.9 0.41 0° 350 171.3 19.89 166.7 0.31	K13-17	00	260	150.0	21.39	150.0	0.38	00/9	
0° 350 190.0 19.74 170.7 0.22 0° 350 151.9 19.59 148.4 0.30 0° 350 194.2 19.59 148.4 0.30 0° 350 176.7 19.79 176.3 0.36 0° 350 143.9 21.27 143.9 0.41 0° 350 171.3 19.89 166.7 0.31	Ave			162.6	21,11	161.5	0.36	7820	
0° 350 190.0 19.74 170.7 0.22 0° 350 151.9 19.59 148.4 0.30 0° 350 194.2 19.05 194.2 0.24 0° 350 176.7 19.79 176.3 0.36 0° 350 143.9 21.27 143.9 0.41 0° 350 171.3 19.89 166.7 0.31	Std.Dev.			7.5	0.68	8.1	0.02	940	
0° 350 190.0 19.74 170.7 0.22 0° 350 151.9 19.59 148.4 0.30 0° 350 176.7 19.05 194.2 0.36 0° 350 176.7 19.79 176.3 0.41 0° 350 143.9 21.27 143.9 0.41 0° 350 171.3 19.89 166.7 0.31							3	0.04.0	
0° 350 151.9 19.59 148.4 0.30 0° 350 194.2 19.05 194.2 0.24 0° 350 176.7 19.79 176.3 0.36 0° 350 143.9 21.27 143.9 0.41 171.3 19.89 166.7 0.31	K12-3	0	350	190.0	19.74	170.7	0.22	2430	and the second section is a second of the second section of the second section is a second section of the second section of the second section is a second second section of the second section is a second section of the section of the second section is a second section of the second section is a second section of the section of t
0° 350 194.2 19.05 194.2 0.24 0° 350 176.7 19.79 176.3 0.36 0° 350 143.9 21.27 143.9 0.41 171.3 19.89 166.7 0.31 27.5 0.82 20.7 0.08	K12-7	00	350	151.9	19.59	148.4	0.30	0009	
0° 350 176.7 19.79 176.3 0.36 0° 350 143.9 21.27 143.9 0.41 171.3 19.89 166.7 0.31 20.7 0.08	713-5	°C	350	194.2	19.05	194.2	0.24	9350	
0° 350 143.9 21.27 143.9 0.41 171.3 19.89 166.7 0.31	×13-0	00	350	176.7	19.79	176.3	0.36	9650	
171.3 19.89 166.7 0.31	21.2-16	٥	350	143.9	21.27	143.9	0.41	6500	
22 F 0 82 20.7 0.08	N12-10		~~	171.3	19.89	166.7	0.31	8390	
70.0	.646	-		22.5	0.82	20.7	0.08	1210	

Test:	Tension			Mate	Material: G-1	G-160/6535-1	Treatment of the second of the	
		Test	Ultimate		Stress at		Ultimate	
Spec.	Fiber	Temp.	Strength		Prop.Lim.	Pois.	Strain	-
No.	Orien.	(°F)	(k3i)		(ksi)	Ratio	(uin/in)	Remarks
K14-2	906	-67	5.15	2.41	2.04		2260	
K15-3	•06	-67	5.36	2.61	1.47	es te	2190	
K16-3	06،	-67	4.39	2.25	1.20	*	1980	
K17-3	•06	-67	4.30	2.31	1.60		1890	
K18-3	°06	-67	5,43	1.76	1.78	-	3160	
Avg.			4,93	2.27	1.58		2290	
Std.Dev.			0.54	0.31	0.35		500	
K45-1	06ء	72	6.15	1.52	6.15	m. m.	3940	
K1.5-1	\$ 06	72	5,36	1.69	5,36		3090	
K16-1	0 06	72	5.33	2,11	5.33		3090	~~
K17-1	, 05	72	5.19	1,69	5,19		3040	
Avg.			5,51	1.82	5.51	***	3290	
Std.Dev.			0.43	0.27	0.43	1 1	440	
K15-4	906	260	3,09	1.73	0.81	44	1820	
K16-4	06،	260	4.28	1.78	0.94		2600	
K17-4	, 06	260	4.43	1.70	4.43	-	2610	
K18-4	, 06	260	3.72	1,33	3.72		2690	
K45-3	06،	260	3.90	1.39	3,90	-	2710	
Avg.			3.88	1.59	2.70	P 9	2490	
Stå. Dev.			0,53	0.21	1.74		380	
K15-2	066ء	350	2.42	1.79	1.97	10 11 11	1360	
K16-2	°06	350	3.27	1.61	3.27	ŀ	2035	
K17-2	°06	350	3.86	1.61	1.89		2510	
K45-2	•06	350	4.41	1.53	2.57	1	3200	
Avg.			3.49	1.63	2.42		227D	
Std.Dev.			0.85	0.11	0.64	2 2 2	780	

Spec. And Communications Treat Temp. Strength (Anglius Prop. Lin.) Initial Stress at Strain (Anglius Prop. Lin.) Pois. Strain (Anglius Prop. Lin.) Olimitial (Anglius Prop. Lin.) Remarks (Anglius Prop. Lin.) Colimitial (Anglius Prop. Lin.) Remarks (Anglius Lin.) <th>Test:</th> <th>Tension</th> <th></th> <th></th> <th>Mat</th> <th>Material: 0-16</th> <th>G-16C/6535-1</th> <th></th> <th></th>	Test:	Tension			Mat	Material: 0-16	G-16C/6535-1		
Fiber Temp. Strength Nodylus Prop.Lim. Pois. Strain Ocien. 0crien. (*F) (ksi) Ratio (µin/in) ±45 -67 18.72 3.20 10.70 0.55 6520 ±45 -67 20.88 3.13 7.50 0.62 5550 ±45 -67 18.95 3.63 12.11 0.62 5650 ±45 -67 18.95 3.63 12.11 0.62 5650 ±45 -67 18.95 3.63 1.21 0.62 5650 ±45 -67 18.93 3.28 3.28 9.64 0.62 5650 ±45 72 15.10 3.15 8.40 0.62 6890 ±45 72 15.45 3.12 5.26 0.66 6100 ±45 72 15.45 3.02 5.26 0.66 6100 ±45 72 15.4 0.021 1.41 0.05 850 <td< th=""><th></th><th></th><th>Test</th><th>Ultimate</th><th>Initial</th><th>Stress at</th><th></th><th>Ultimate</th><th></th></td<>			Test	Ultimate	Initial	Stress at		Ultimate	
45 (F31) (10 ⁰ ps1) (ks1) Ratio (µin/in) ±45 -67 18.72 3.20 10.70 0.55 6520 ±45 -67 19.71 3.14 7.73 0.65 6520 ±45 -67 18.98 3.28 3.18 0.62 6520 ±45 -67 18.98 3.28 9.64 0.62 550 ±45 -67 18.95 3.28 9.64 0.62 560 ±45 -67 18.95 3.28 9.64 0.62 5600 ±45 -67 18.95 3.28 9.64 0.66 6120 ±45 72 17.70 3.15 8.40 0.66 6120 ±45 72 15.36 3.13 5.46 0.04 1380 ±45 72 15.36 3.13 5.46 0.66 6400 ±45 72 15.36 3.13 5.46 0.60 6400	Spec	Fiber	Temp.	Strength	Modulus	Prop. Lim.	Pois.	Strain	
±45 -67 18.72 3.20 10.70 0.65 6520 ±45 -67 19.71 3.14 7.73 0.62 6950 ±45 -67 19.71 3.13 7.50 0.63 6950 ±45 -67 18.95 3.63 12.11 0.66 6120 ±45 -67 18.95 3.63 12.11 0.66 6120 ±45 -67 18.95 3.63 12.11 0.66 6120 ±45 72 16.36 3.29 4.96 0.04 1380 ±45 72 15.36 3.13 5.46 0.66 6200 ±45 72 15.36 3.12 5.26 0.05 6300 ±45 72 15.36 3.12 5.26 0.65 6300 ±45 72 15.45 3.02 5.24 0.65 6300 ±45 260 15.14 0.12 1.41 0.05 8	No.	Orien.	(°F)	(ksi)	(10°psi)	(ksi)	Ratio	(nin/in)	Remarks
± 45 -67 19.71 3.14 7.73 0.62 6950 ± 45 -67 20.68 3.13 7.50 0.63 9200 ± 45 -67 18.98 3.13 7.50 0.62 6950 ± 45 -67 18.93 3.28 9.53 0.62 6890 ± 45 -67 19.43 3.28 9.53 0.62 6890 ± 45 -67 0.90 0.21 1.96 0.04 1380 ± 45 72 17.70 3.15 6.40 0.04 1380 ± 45 72 17.77 2.99 5.26 0.66 6100 ± 45 72 17.77 2.99 5.26 0.66 6100 ± 45 72 17.77 2.99 2.6 0.66 6100 ± 45 72 15.45 3.10 0.12 0.65 6940	K4-4	±45	-67	18.72	3.20	10.70	0.55	6520	
±45 -67 20.88 3.13 7.50 0.63 9200 ±45 -67 15.88 3.28 9.64 0.62 5650 ±45 -67 16.88 3.28 9.64 0.62 5650 ±45 -67 19.43 3.28 9.53 0.66 6800 ±45 72 17.10 3.15 8.40 0.68 7600 ±45 72 15.36 3.13 5.46 0.68 6400 ±45 72 15.36 3.13 5.46 0.60 6400 ±45 72 15.45 3.02 5.26 0.66 8100 ±45 72 15.45 3.02 5.24 0.60 6400 ±45 72 15.45 3.02 5.26 0.66 8100 ±45 260 15.17 2.85 4.48 0.05 850 ±45 260 15.51 3.06 3.58 0.72 1300 <td>K6-2</td> <td>±45</td> <td>-67</td> <td>19.71</td> <td>3.14</td> <td>7.73</td> <td>0.62</td> <td>6950</td> <td></td>	K6-2	±45	-67	19.71	3.14	7.73	0.62	6950	
±45 -67 15.88 3.28 9.64 0.62 550 ±45 -67 18.95 3.63 12.11 0.66 6120 ±45 -67 18.95 3.63 12.11 0.66 6120 ±45 72 17/10 3.15 8.40 0.64 1380 ±45 72 15.36 3.13 5.46 0.68 7600 ±45 72 15.36 3.13 5.46 0.60 6400 ±45 72 15.45 3.02 5.26 0.66 8100 ±45 72 15.45 3.02 5.26 0.66 8100 ±45 260 15.71 2.85 4.48 0.73 1220 ±45 260 15.91 3.02 3.54 0.65 6400 ±45 260 15.91 3.02 3.48 0.73 10.00 ±45 260 15.91 3.02 3.79 0.72 115	K7-4	445	<i>L</i> 9-	20.88	3.13	7.50	0.63	9200	
445 -67 18.95 3.63 12.11 0.66 6120 445 19.43 3.28 9.53 0.62 6890 445 72 17/10 3.15 8.40 0.63 7600 445 72 16.36 3.29 4.96 0.73 6400 445 72 15.36 3.13 5.46 0.66 8100 445 72 15.36 3.02 5.26 0.66 8100 445 72 15.36 3.02 5.26 0.66 8100 445 260 17.77 2.85 4.48 0.73 1220 445 260 15.91 3.05 4.61 0.05 850 445 260 15.91 3.05 4.63 0.73 1280 445 260 15.91 3.05 4.61 0.72 1280 445 360 15.51 3.05 4.61 0.72 15.20 <	K10-3	±45	<i>19-</i>	15.88	3.28	9.64	0.62	5650	
45.4 3.28 9.53 0.62 6890 445 72 17/10 3.15 8.40 0.68 7600 445 72 15.36 3.29 4.96 0.73 6400 445 72 15.36 3.13 5.46 0.60 6200 445 72 15.36 3.13 5.46 0.60 6200 445 72 15.36 3.13 5.46 0.60 6200 445 72 17.77 2.99 5.26 0.66 8100 445 72 15.45 3.02 5.54 0.65 6400 445 72 15.45 3.02 5.54 0.66 8100 445 260 15.91 3.09 3.58 0.61 12800 445 260 15.91 3.06 4.61 0.72 13700 445 260 15.91 3.05 4.61 0.72 13700 445 <td>K11-1</td> <td>577</td> <td><i>1</i>9-</td> <td>18.95</td> <td>3.63</td> <td>12.11</td> <td>0.66</td> <td>6120</td> <td></td>	K11-1	5 77	<i>1</i> 9-	18.95	3.63	12.11	0.66	6120	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Avg.			19.43	3.28	9.53	0.62	0689	
±45 72 17170 3.15 8.40 0.68 7600 ±45 72 15.36 3.129 4.96 0.63 6.600 ±45 72 15.36 3.13 5.46 0.66 6400 ±45 72 15.36 3.02 5.26 0.66 8100 ±45 72 15.43 3.02 5.24 0.66 6400 ±45 16.53 3.12 5.26 0.66 6400 ±45 260 15.71 0.12 1.41 0.05 850 ±45 260 15.91 3.09 3.58 0.61 12800 ±45 260 15.75 3.13 4.63 0.73 1370 ±45 260 14.88 3.11 5.60 0.72 1370 ±45 350 15.56 3.05 4.61 0.72 2.50 ±45 350 17.32 2.81 4.46 0.77 1500	Std.Dev.			06.0	0.21	1.96	0.04	1380	
±45 72 17/10 3.15 8.40 0.68 7600 ±45 72 16.36 3.13 5.46 0.03 6400 ±45 72 15.36 3.13 5.46 0.60 6200 ±45 72 15.36 3.13 5.46 0.60 6200 ±45 72 15.45 3.02 5.26 0.66 8100 ±45 72 15.45 3.02 5.54 0.66 8100 ±45 260 47 0.12 1.41 0.05 6400 ±45 260 15.91 3.09 3.58 0.61 12200 ±45 260 15.91 3.09 3.58 0.73 12200 ±45 260 15.71 3.09 3.58 0.72 13700 ±45 260 15.75 3.13 4.63 0.72 10.70 ±45 260 15.56 3.05 4.61 0.72 15.20				Ī					
±45 72 16.36 3.29 4.96 0.73 6400 ±45 72 15.36 3.13 5.46 0.60 6200 ±45 72 15.36 3.13 5.26 0.66 8100 ±45 72 15.45 3.02 5.54 0.66 8100 ±45 72 15.45 3.02 5.54 0.66 6400 ±45 260 1.17 0.12 1.41 0.05 850 ±45 260 15.91 3.09 3.58 0.05 820 ±45 260 15.91 3.06 4.76 0.72 13700 ±45 260 15.51 3.05 4.63 0.72 13700 ±45 260 14.88 3.11 5.60 0.75 1520 ±45 260 15.56 3.05 4.61 0.72 1520 ±45 350 17.48 0.12 0.72 1520	K5-1	±45	72	171.70	3.15	8.40	0.68	7600	
±45 72 15.36 3.13 5.46 0.60 6200 ±45 72 17.77 2.99 5.26 0.66 8100 ±45 72 15.45 3.02 5.54 0.66 8100 ±45 16.53 3.02 5.54 0.66 6400 ±45 260 1.17 0.12 1.41 0.05 850 ±45 260 15.91 3.09 3.58 0.73 12200 ±45 260 15.91 3.06 4.76 0.73 13700 ±45 260 15.91 3.05 4.63 0.73 13700 ±45 260 15.51 3.05 4.61 0.75 13700 ±45 350 14.88 3.11 5.60 0.75 15.50 ±45 350 17.48 2.81 4.46 0.72 26200 ±45 350 17.32 2.91 4.46 0.75 43400	K6-1	±45	72	16.36	3.29	4.96	0.73	6400	
±45 72 17.77 2.99 5.26 0.66 8100 ±45 72 15.45 3.02 5.54 0.65 6400 ±45 16.53 3.12 5.92 0.65 6400 ±45 260 1.17 0.12 1.41 0.05 850 ±45 260 15.91 3.09 3.58 0.73 12200 ±45 260 15.91 3.06 4.76 0.73 12200 ±45 260 15.91 3.06 4.76 0.73 1280 ±45 260 15.75 3.13 4.63 0.72 13700 ±45 260 15.56 3.05 4.61 0.75 15.20 ±45 350 17.48 3.11 5.60 0.72 26200 ±45 350 17.01 2.81 4.46 0.72 26200 ±45 350 17.01 2.81 4.46 0.72 26200 <td>K7-1</td> <td>±45</td> <td>72</td> <td>15.36</td> <td>3.13</td> <td>5.46</td> <td>0.60</td> <td>6200</td> <td></td>	K7-1	±45	72	15.36	3.13	5.46	0.60	6200	
± 45 72 15.45 3.02 5.54 0.60 6400 ± 45 16.53 3.12 5.92 0.65 6940 ± 45 2.60 1.17 0.12 1.41 0.05 850 ± 45 2.60 ± 7 2.85 4.48 0.73 12200 ± 45 2.60 15.91 3.06 4.76 0.72 1300 ± 45 2.60 15.75 3.13 4.63 0.79 10700 ± 45 2.60 14.88 3.11 5.60 0.72 1300 ± 45 2.60 14.88 3.11 5.60 0.72 10700 ± 45 3.50 17.48 2.81 4.46 0.72 15.00 ± 45 3.50 17.32 2.91 4.46 0.75 43400 ± 45 3.50 17.01 2.81 4.01 0.75 34800	K8-1	±45	72	17.77	2.99	5.26	0.66	8100	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	K9-1	±45	72	15.45	3.02	5.54	0.60	6400	
±45 260 17 2.85 4.48 0.73 1200 ±45 260 15.71 3.09 3.58 0.73 12200 ±45 260 15.91 3.06 4.76 0.73 12200 ±45 260 15.75 3.13 4.63 0.72 13700 ±45 260 15.75 3.13 4.63 0.75 13700 ±45 260 15.56 3.05 4.61 0.75 8200 ±45 350 17.48 2.70 3.79 0.07 2150 ±45 350 17.01 2.81 4.46 0.70 6000+ ±45 350 17.01 2.81 4.46 0.75 43400 ±45 350 17.01 2.81 4.05 0.75 34800 ±45 350 17.01 2.81 4.05 0.75 34800 ±45 350 15.08 0.72 34800 0.72	Avg.			16.53	3.12	5.92	0.65	6940	
±45 260 ±7 2.85 4.48 0.73 12200 ±45 260 15.91 3.09 3.58 0.61 12800 ±45 260 15.91 3.06 4.76 0.72 13700 ±45 260 15.75 3.13 4.63 0.79 10700 ±45 260 14.88 3.11 5.60 0.75 8200 ±45 260 14.88 3.11 5.60 0.75 8200 ±45 350 15.56 3.05 4.61 0.75 8200 ±45 350 17.48 2.81 4.15 0.07 26200 ±45 350 17.32 2.91 4.46 0.70 6000+ ±45 350 17.01 2.81 4.01 0.75 43400 ±45 350 15.08 2.73 4.05 0.75 34800 ±45 350 17.00 0.08 0.07 34800 </td <td>Std.Dev.</td> <td></td> <td></td> <td>1.17</td> <td>0.12</td> <td>1.41</td> <td>0.05</td> <td>850</td> <td></td>	Std.Dev.			1.17	0.12	1.41	0.05	850	
±45 260 47 2.85 4.48 0.73 12200 ±45 260 15.91 3.09 3.58 0.61 12800 ±45 260 15.91 3.06 4.76 0.72 13700 ±45 260 15.75 3.13 4.63 0.79 10700 ±45 260 14.88 3.11 5.60 0.75 8200 ±45 260 0.41 0.12 0.72 0.75 8200 ±45 350 17.48 2.81 4.15 0.68 18000+ ±45 350 17.32 2.91 4.46 0.70 6000+ ±45 350 17.01 2.81 4.46 0.75 43400 ±45 350 17.01 2.81 4.01 0.75 43400 ±45 350 15.08 2.73 0.75 7200+ ±45 350 16.48 2.73 4.05 0.75 34800 <									
$+45$ 260 15.91 3.09 3.58 0.61 12800 $+45$ 260 15.91 3.06 4.76 0.72 13700 ± 45 260 15.75 3.13 4.63 0.72 13700 ± 45 260 14.88 3.11 5.60 0.75 8200 ± 45 260 0.41 0.12 0.72 0.07 1150 ± 45 350 17.48 2.81 4.15 0.68 $18000+$ ± 45 350 17.32 2.91 4.46 0.70 $6000+$ ± 45 350 17.01 2.81 4.01 0.75 43400 ± 45 350 17.01 2.81 4.01 0.75 43400 ± 45 350 17.01 2.81 4.05 0.75 $7200+$ ± 45 350 17.01 2.81 4.05 0.75 34800 ± 45 350 15.08 2.73 3.08 0.75 3.4800	K4-2	±45	260	. 47	2.85	4.48	0.73	12200	
± 45 260 15.91 3.06 4.76 0.72 13700 ± 45 260 15.75 3.13 4.63 0.79 10700 ± 45 260 14.88 3.11 5.60 0.75 8200 ± 45 260 0.41 0.12 0.72 0.07 11520 ± 45 350 17.48 2.81 4.15 0.68 $18000+$ ± 45 350 17.32 2.91 4.46 0.70 $6000+$ ± 45 350 17.01 2.81 4.01 0.75 43400 ± 45 350 17.01 2.81 4.01 0.75 43400 ± 45 350 17.01 2.81 4.01 0.75 43400 ± 45 350 17.01 2.81 4.05 0.75 34800 ± 45 350 15.08 2.79 4.05 0.75 34800	K5-2	+45	260	15.21	3.09	3.58	0.61	12800	
± 45 260 15.75 3.13 4.63 0.79 10700 ± 45 260 14.88 3.11 5.60 0.75 8200 ± 45 260 0.41 0.12 0.72 0.72 11520 ± 45 350 15.52 2.70 3.79 0.07 2150 ± 45 350 17.48 2.81 4.46 0.70 $6000+$ ± 45 350 17.01 2.81 4.46 0.70 $6000+$ ± 45 350 17.01 2.81 4.01 0.75 43400 ± 45 350 17.01 2.81 4.05 0.75 $7200+$ ± 45 350 15.08 2.73 3.82 0.75 34800 1.10 0.08 0.28 0.03 0.03	K7-2	+45	260	15.91	3.06	4.76	0.72	13700	
± 45 260 14.88 3.11 5.60 0.75 8200 ± 45 15.56 3.05 4.61 0.72 11520 ± 45 350 15.52 2.70 3.79 0.07 2150 ± 45 350 17.48 2.81 4.15 0.68 $18000+$ ± 45 350 17.01 2.81 4.46 0.70 $6000+$ ± 45 350 17.01 2.81 4.01 0.75 43400 ± 45 350 17.01 2.81 4.05 0.75 $7200+$ ± 45 350 15.08 2.73 4.05 0.75 34800 1.10 0.08 0.28 0.03 0.03	K9-2	±45	260	15.75	3.13	4.63	0.79	10700	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	K10-1	±45	260	14.88	3.11	5.60	0.75	8200	
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	AVG			15,56	3.05	4.61	0.72	11520	
±45 350 15.52 2.70 3.79 0.72 26200 ±45 350 17.48 2.81 4.15 0.68 18000+ ±45 350 17.32 2.91 4.46 0.70 6000+ ±45 350 17.01 2.81 4.01 0.75 43400 ±45 350 15.08 2.73 3.82 0.75 7200+ 16.48 2.79 4.05 0.72 34800 1.10 0.08 0.28 0.03	Std.Dev.			0.41	0.12	0.72	0.07	2150	
± 45 350 15.52 2.70 3.79 0.72 26200 ± 45 350 17.48 2.81 4.15 0.68 $18000+$ ± 45 350 17.01 2.81 4.46 0.70 $6000+$ ± 45 350 17.01 2.81 4.01 0.75 43400 ± 45 350 15.08 2.73 3.82 0.75 $7200+$ 16.48 2.79 4.05 0.72 34800 1.10 0.08 0.28 0.03									
± 45 350 17.48 2.81 4.15 0.68 $18000+$ ± 45 350 17.32 2.91 4.46 0.70 $6000+$ ± 45 350 17.01 2.81 4.01 0.75 43400 ± 45 350 15.08 2.73 3.82 0.75 $7200+$ 16.48 2.79 4.05 0.72 34800 1.10 0.08 0.28 0.03	K4-3	+45	350	15.52	2.70	3.79	0.72	26 200	
±45 350 17.32 2.91 4.46 0.70 6000+ ±45 350 17.01 2.81 4.01 0.75 43400 ±45 350 15.08 2.73 3.82 0.75 7200+ 16.48 2.79 4.05 0.72 34800 1.10 0.08 0.28 0.03	X5-3	±45	350	17.48	2.81	4.15	0.68	18000+	
±45 350 17.01 2.81 4.01 0.75 43400 ±45 350 15.08 2.73 3.82 0.75 7200+ 16.48 2.79 4.05 0.72 34800 1.10 0.08 0.28 0.03	K7-3	±45	350	17.32	2.91	4.46	0.70	+0009	
±45 350 15.08 2.73 3.82 0.75 7200+ 16.48 2.79 4.05 0.72 34800 1.10 0.08 0.28 0.03	K9-3	±45	350	17.01	2.81	4.01	0.75	43400	
16.48 2.79 4.05 0.72 34800 1.10 0.08 0.28 0.03	K10-2	±45	350	15.08	2.73	3.82	0.75	7200+	gage failed
1.10 0.08 0.28	Avg.			16.48	2.79	4.05	0.72	34800	excludes K5-3,K7-3,K10-2
	Std.Dev.			1.10	0.08	0.28	0.03		

Spec. Fiber No. Orien. K34-3 0/4451 K35-4 0/4451 K36-3 0/4451 K36-3 0/4451 K36-3 0/4451 K36-3 0/4451 K37-3 0/445/90 K37-3 0/445/90 K37-7 0/445/90 K38-9 0/445/90 K39-4 0/445/90 K24-1 0/445/90 K24-1 0/445/90 K25-1 0/445/90 K25-1 0/445/90 K25-1 0/445/90 K25-1 0/445/90 K25-1 0/445/90 K25-1 0/445/90	Tension		Mate	Material: G-1	G-160/6535-1		
	Test	Ultimate		Stress at		Ultimate	
	Temp.	Strength		Prop. Lim.	Pois.	Strain	
	(°F)	(k3i)	(10°psi)	(ksi)	Ratio	(ui/uin)	Remarks
	72	88.27	9.76	83.27	0.59	8200	
	72	94.23	11.54	94.23	0,67	7000	
	7.2	99.62	12.67	99.62	0.62	8500.	
	7.2	103.21	10.99	103.21	0.58	8690	
	72	101.08	12.07	101.08	0.66	8450	
		97.28	11.41	97.28	0,62	8170	
		6.03	1.11	6.03	0.04	680	
	7.2	98.21	11.60	98.21	0.42	8220	
	7,2	90.40	11.76	90.40	0.42	7540	
	7.2	87.10	12.53	87.10	0.39	6950	
	72	101.99	11.39	101.99	0.43	8720	
	72	79.90	10.68	79.90	0.40	7250	
		91.52	11.59	91,52	0.41	7740	
		8.81	0.67	18.8	0.02	720	
	7.2	100,72	10.74	100.72	0.36	9160	
		88.22	10.95	88.22	0.37	8080	
	72	90.76	11.04	90,76	0.36	8200	
	72	06.68	10.87	89.90	0.36	7880	
Avg.	72	84.78	11.00	84.78	0.40	7730	
		90.88	10.92	90.38	0.37	8210	
Std.Dev.		5.36	0.12	5.96	0.02	560	
1(0,45,-45,0,0,-45,45,0) _S -16	5,45,0)s-16	ply; ² (0,90,	45,-45,0,0,-	2(0,90,45,-45,0,0,-45,45,0,0)s-20 ply;	ì	0,45,-45,0,0,	3(0,45,-45,0,0,-45,45,0,90,0)s-20 ply

APPENDIX E COMPRESSION DATA

All of the compression data generated during this program are presented in this section. They are summarized in tabular and graphical form in Sections 4.1 through 4.6.

Test:	Compression	ston			Material: T300/AFR800	300/AFR800	
		Test	Ultimate	Initial	Stress at	מ	
Spec. No.	Fiber Orlen.	Temp.	Strangth (10 ³ psi)	Modulus (10 ⁶ psi)	Prop.Lim. (103psi)	Strain (p in/in)	Remarks
F35-12	0.	-67	224.8	17.93	84.8	25,000	
F35-13	0	-67	208.3	19.91	69.4	22,500	
F35-14	0.0	-67	190.0	17.80	48.0	14,500	
F35-19	a D	-67	219.2	22.67	54.0	11,500	
F36-2	0 ه	-67	186.4	17.43	74.1	18,000	
Avg.			205.6	19.15	66.1	18,300	
Std.Dev.			17.0	2.19	15.0	5,600	
F35-4	°D	72	145.6	19.77	19.8	9,600	
F35-5	0.0	72	189.3	17.52	19.8	11,800	
F35-7	° 0	72	192.9	12.21	33.3	20,800	
F35-9	0ء	72	159.8	15.26	112.3	13,000	
F35-11	0ء	72	185.6	15.14	38.6	18,500	
Avg.			174.6	15.98	44.8	14,700	
Std.Dev.			23.0	2.85	38.7	4,700	
F35-6	0.	260	149.5	16.97	59.4	11,300	
F35-B	0.0	260	194.1	15.40	119.1	16.300	
F36-1	0.0	260	220.5	22.90	48.7	13,700	
F36-3	0.	260	167.6	15.99	102.7	15,800	
F36-4	0.0	260	209,5	20.64	47.0	15,000	
Avg.			188.2	18.38	75.4	14,400	
Std.Dev.			29.4	3.24	33.3	2,000	
F35-1	٥.	350	163.7	17.11	63.9	008'6	
F35-10	0.0	350	206.3	23.86	56.8	9,800	
F35-15	0.0	350	157.4	19.53	41.5	7,300	
F35-16	0.	350	130.4	22.58	31.1	6,700	
F36-11	0.0	350	163.3	20.45	163.3	8,100	
Avg.			- 164.2	20.71	71.3	8,300	
Std.Dev.			27.2	2.64	53.0	1,400	

Test:	Compression	ion			Material:	T300/AFR300	
	4					1	
Space	i de	Test	Ultimate	Initial	Stress at	Ultimate Ctrain	
No.	orien.	(°F)	(10 ³ psi)	(10 ⁶ ps1)	(10 ³ psi)	~_	Remarks
F35-3	90.	-67	29.5	1.87	10.1	39,800	
F35-5	0 06	-67	40,5	1.78	12.6	28.800	
F35-15	• 06	-67	42.3	1.41	25.6	37,300	
F35-23	90°	-67	55.3	1.49	11.1	26.800	
F36-9	°06	-67	23.9	1.96	9,0	25,000	
Avg.			38.4	1.70	13.7	31.500	
Std.Dev.			12.4	0.24	6.8		
F36~6	90°	72	39.1	2.91	39.1	14,800	
F36-8	90.	72	40.8	2.22	40.3	13.500+	Evidence of buckling
F36-14	906	72	40.3	2.58	6.0	31,000	
F36-18	900	72	45.7	2.44	45.1	21,000	
F36-23	•06	72	32.4	2.30	32.5	9,100+	Evidence of buckling
Avg.			39.7	2.50	32.8	17,900+	
Std.Dev.			4.8	0.27	15.7	9,000	
F35-15	°06	260	29.9	1.40	29.9	9.800	
F35-21	90°	260	26.7	1.57	23.9	9.800±	Evidence of buckling
F35-27	•06	260	29.2	1.40	1.9	20,000	
F36-2	90°	260	27.0	1.55	10.4	13,700	
F36-15	06،	260	29.2	1.58	29.2	10,000+	Evidence of buckling
Avq.			28.4	1,50	18.9	12,700+	
Std.Dev.			1.5	0.09	12.4	4,400	
F35-1	906	350	25.1	1.44	9.8	34,300	
F35-11	•06	350	27.5	1.91	27.5	13,300	
F35-24	06ء	350	23.0	1.56	11.0	33,300	
F35-30	°06	350	32.7	2.77	32.7	21,800	
F36-14	906	350	30.4	2,42	30.4	35,300	
Avg.			27.7	2.02	22.3	25,800	
Std.Dev.			3.9	0.57	11.0	9,800	

	Test (°F) -67 -67 -67 -67 -72 -72 72 72	Ultimate Strength (10 ³ psi) 400.1 396.3 434.9	Initial Modulus	Stress at Prop.Lim.	Ultimate Strain	
	Temp. (°F) -67 -67 -67 -67 -72 72 72 72	Strength (10 ³ psi) 400.1 396.3 434.9	Modulus	Prop.Lim.	Strain	
	-67 -67 -67 -67 -72 72 72 72	400.1 396.3 434.9	(10°psi)	(10°psi)	(h in/in)	Remarks
	-67 -67 -67 -67 -72 72 72 72 72	396.3 434.9	33.06	275.6	+ 008 '6	Evidence of buckling
	-67 -67 -67 -72 72 72 72 72	434.9	33.06	295.3	15,700	ageneratera, ent minimalistica estata de la compania del la compania de la compania de la compania de la compania de la compania del la compania de la compania del la compa
	-67 -67 72 72 72 72 72		33.04	184.4	16,900	
	-67 72 72 72 72 72	387.8	28.96	305.0	15,400	
	72 72 72 72 73	334.7	37.29	160.3	7,300+	Evidence of buckling
	72 72 72 72 72	390.8	33.08	244.1	12,920+	
	72 72 72 72 72	36.1	2.95	6.99	4,310	
	72 72 72 72					
	72 72 72	338.0	32.01	81.6	5,400+	Tabs debonded. Retabbed with
	72 72 72	350.0	34.94	82.5	4,500+	different adhesive and tests
	72	305.4	39.77		6,250+	rerun.
	72	322.4	34.58		+006'5	
	The real Property lies and the least lies and the l	332.7	36.28	177.3	+001'6	*
5		329.7	35,52	113.8	6,220+	
		16.8	2.84	55.0	1,730	
	260	228.8	34.17	102.8	7,200	
	260	233.2	39.09	182.0	7,600	
	260	220.6	30.74	164.8	8,800	
	260	240.3	31.79	124.6	6,200	
	260	239.1	33.53	131.4	8,800	
		232.4	33.86	141.1	7,760	
		8.1	3.22	31.9	1,110	
+	350	153.3	34.18	82.5	3,800+	Evidence of buckling
+	350	97.3	27.38	91.3	3,700	
	350	102.5	27.43	100.8	3,700	
G42-13 0°	350	146.9	46.96	106.1	3,050+	Evidence of buckling
G42-15 0°	350	154.3	33.81	95.1	3,530	
Avg.		130.9	33.95	95.2	3,560+	
Std.Dev.		28.5	7.98	0.6	300	

Test:	Compression	sion			Material:	sic/5506	
		Test	Ultimate	Initial	Stress at	Ultimate	
Spec.	Fiber Orien.	Temp.	Strength (10 ³ psi)	Modulus (10 ⁶ ps1)	Prop.Lim. (103psi)	Strain (u in/in)	Remarks
G42-15	06	-67	56.6	3.97	11.0	19,200	
642-26	,06	-67	57.7	4.34	13.4	18,100	
G42-36	06ء	-67	53.4	3.84	14.4	24,100	
G42-46	06،	-67	53.7	2.97	11.0	25,700	
G42~52	406	-67	62.3	1.93	27.9	23,900	
Avg.			56.7	3.41	15.5	22,200	
Std. Dev.			3.6	0.97	7.1	3,340	
							- 1
G42-1	°06	72	34.1	4.38	8.7	4,100+	- 1
G42-14	90ء	72	31.8	3.30	11.6	1,000+	evidence of Duckling
642-27	°06	72	35.5	3.03	30.5	12,000	1
G42~32	06	72	34.4	4.05	15.1	₹006.9	evidence of buckling
647-45	006	72	36.3	3.13	24.2	16.200	
Avg.			34.4	3.58	13.0	9,240+	
Std. Dev.			1.7	0.60	9.1	4,820	
G42-7	°06	260	26.9	2.54	14.0	16,700+	evidence of buckling
G42-17	°06	260	26.7	2.41	16.9	24,200	
G42-18	e 06	260	23.0	2.39	10.6	23,400	
G42-21	•06	260	25.9	2.22	11.9	21,700	
G42-35	•06	260	25.7	2.44	17.9	16,700+	evidence of buckling
Avg.			25.7	2.40	14.3	20.540+	
Std.Dev.			1.5	0.12	3.2	3,620	
G42-6	06	350	21.6	1.87	9.6	24,800	
642-10	°06	350	18.7	1.83	7.4	31,200	
642-25	06	350	20.4	1.43	10.5	24,700	
642-35	•06	350	18.8	1.94	12.4	+009'9	evidence of buckling
642-37	. 06	350	19.3	2.34	7.0	27,700	
Avg.			19.8	1.88	9.4	27,100*	*excludes 642-35
Std.Dev.			1.2	0.32	2.2	3,0/0*	

c. Fiber Orien. O° O° O° O° O° O° O° O° O° O	Test (°F) (°F) -67 -67 -67 -67	Ultimate Strength (103psi) 61.24 53.27 56.64 52.02 45.87 53.81 5.69 41.91	Initial Modulus (10 6ps1) 42.29 38.57 37.19 33.96 33.96	Stress at Prop. Lim. (10 ³ psi) 28.45	—	
c. Fiber Orien. V. O° O° O° O° O° O° O° O° O° O	Temp. (°F) -67 -67 -67 -67 -57 -57 -57 -57 -57 -57 -57	Strength (10 ³ psi) 61.24 53.27 56.64 52.02 45.87 53.81 5.69	Modulus (10 bs1) 42.29 38.57 37.19 33.96 33.96	O1 C	•	
v. v. 0° 0° 0° 0° 0° 0° 0° 0° 0° 0° 0° 0° 0°	-67 -67 -67 -67 -67 -72	(10 ³ psi) 61.24 53.27 56.64 52.02 45.87 53.81 5.69	(10°pst) 42.29 38.57 37.19 33.96 33.96	(10 ³ ps1) 28.45 39.14		
v. 00 00 00 00 00 00 00 00 00 00 00 00 00	-67 -67 -67 -67	61.24 53.27 56.64 52.02 45.87 53.81 5.69	42.29 38.57 37.19 33.96 33.12	28.45	(n in/in)	Remarks
v. v	-67 -67 -67 -67	53.27 56.64 52.02 45.87 53.81 5.69	38.57 37.19 33.96 33.12 37.03	39.14	2000	
v. v	-67 -67 -67	56.64 52.02 45.87 53.81 5.69 41.91	37.19 33.96 33.12		1400	
v. v	-67	52.02 45.87 53.81 5.69 41.91	33.96 33.12 37.03	44.34	1700	
v. v	72	53.81 5.69 5.69 41.91	33.12	34,88	1,900	
v. v	72	5.69	37.03	31.47	1700	
v. v	72	5.69		35.66	1740	
	72	41.91	3.70	6.28	230	
, 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	72	41.91				
v. 000 00 00 00 00 00 00 00 00 00 00 00 0	í	47 43	39.91	39.81	1100	
v. 000 00 00 00 00 00 00 00 00 00 00 00 0	7/	75.05	37.64	38.09	1500	
0°°°°°°°°°°°°°°°°°°°°°°°°°°°°°°°°°°°°°	72	44.60	64.00	14.40	1000	
v. 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	72	53.08	41.15	12.55	1700	
v. 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	72	55.56	46.78	24.00	1200	
000000000000000000000000000000000000000		48.51	45.90	25.77	1300	The state of the s
, 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		5.71	10.67	12.81	290	
, 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	-					
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	260	31.16	54.53	13.90	1100	
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	260	43.60	46.84	14.34	1200	The second secon
0°°°°°°°°°°°°°°°°°°°°°°°°°°°°°°°°°°°°°	260	48.00	46.65	19.18	1200	
v. 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	260	46.32	38.92	32.65	1400	And the second s
000000000000000000000000000000000000000	260	40.93	34.49	33.68	1700	The second secon
00.0000		42.00	44.29	22.75	1320	
0000		6.63	7.77	9.73	240	
0000						
• O	350	48.53	55.78	20.08	1200	#H29-11 broke at end, just inside
000	350	42.99	46.18	29.90	1100	1
0	350	8.73*	40.40	8,49*	200*	in center of gage section.
	350	32.21	41.90	16.98	1,200	
20 0°	350	44.38	32.86	34.14	1200	
Avg.		42.03*#	43.42	25.28**	1180**	**excludes H29-11
Std.Dev.		6.96	8.42	8.08	50	

Test:	Compression	sion			Material:	HyE 2034D	hadestell most three repetitions desirable to the figure questions and the second statements of the second
Spec.	Fiber	Test Temp.	Ultimate Strength	Initial	Stress at Prop.Lim.	Ultimate Strain	
No.	Orien.	(°F)	(10 ³ psi)	(10 ⁶ ps1)	(10 3ps1)	~	Remarks
н 2 9-е	. 06	-67	15.12	1.00	5.48	18500	
H29-11	。 06	-67	20.41	1.23	15.59	18800	
H29-10	906	-67	20.88	2.18	2,30	21100	
H30-2	。 06	-67	19.92	2.65	3.67	21500	
H29-2	0 06	-67	ret ven een	**		*******	Broke in mounting
Avg.			19.08	1.76	ŏ.76	19980	
Std.Dev.			2.67	0.78	6.03	1540	
H29-19	06،	72	16.00	1.77	1.53	30100	
н29-23	• 06	72	3.35	********	2.33	3200	Probable damage before testing
H30-3	906	72	15,07	1,36	2,22	53500	
H30-7	90ء	72	16.73	1.48	2.15	34400	
H30-9	90°	72	22.38	1.88	6.80	25800	
Avg.			17.55	1.62	3.17	35950	Averages exclude H29-23
Std.Dev.			3.30	0.24	2.44	12220	, ,
H30-14	60ء	260	12.58	0.78	1.56	14700	
H30-19	0 6	260	12.17	1.40	12.17	8000	
H29-20	90ء	260	12.08	1.07	12.03	12300	
H29~25	06ء	260	14.69	1.45	2.04	15900	
H29-34	06،	260	13.72	1.47	5.02	18500	
Avg.			13.05	1,24	6.58	13880	
Std.Dev.			1.13	0.30	5.22	3970	
H29-22	60ء	350	12.50	0.90	4.56	22700	
н29-29	°06	350	11.50	0.92	2.11	19400	
н29-16	06،	350	8.75	1.09	1.86	21900	
н29-28	. 06	350	12.25	0.76	1.44	31400	
H29-7	°06	350	12.43	0.95	0.99	29800	
Avg.			11.49	0.92	2.19	25040	
Std.Dev.			1.58	0.12	1.39	5.250	e deservations de la lateration de lateration de lateration de la lateration de la lateration de lateration

Spec. Fiber Orien. Test (rep) Ultimate Strength (100 pgs1) Initial (100 pgs1) Strength (100 pgs1) Holdylus (100 pgs1) Crop in (100 pgs1) <th>Test:</th> <th>Compression</th> <th>sion</th> <th></th> <th></th> <th>Material:</th> <th>T300/V378A</th> <th>and the second of the second deposition of the second seco</th>	Test:	Compression	sion			Material:	T300/V378A	and the second of the second deposition of the second seco
Orien. (**) (103)***II (104)***II (103)***II (104)***II	0	5 7 8	Test	Ultimato	Initial	Stress at		
0° -67 220.4 18.15 64.7 20,500 0° -67 238.1 19.36 48.2 8,700+ 0° -67 213.2 19.83 25.0 9,500+ 0° -67 213.2 17.85 51.3 17,100 0° -67 205.7 17.99 37.1 8,900+ 0° -67 205.7 19.56 45.3 17,100 0° -67 17.9 1.66 45.3 17,100 0° 72 193.2 19.6 45.3 17,000 0° 72 198.2 19.35 16,300 16,300 0° 72 198.2 19.25 16,000 16,400 0° 72 198.2 19.35 16,000 16,000 0° 72 198.2 19.35 16,000 16,000 0° 350 162.4 21.21 140.0 16,100 0° 350 166.9	No.	Orien.	(°F)	(10^3psi)	(10°psi)	(10 ³ psi)	1	Remarks
0° -67 238.1 19.96 48.2 8,700+ 0° -67 213.2 19.83 25.0 9,500+ 0° -67 213.2 17.85 51.3 17,100 0° -67 205.7 21.99 37.1 8,900+ 0° -67 205.7 19.56 45.3 12,900+ 0° 72 193.2 15.6 44.8 17,000 0° 72 168.5 20.95 53.6 16,300 0° 72 198.2 19.25 190.6 16,300 0° 72 198.2 19.35 190.6 16,300 0° 72 198.2 190.6 16,300 16,300 0° 72 198.2 190.6 16,300 16,300 0° 72 196.2 190.6 16,300 16,300 0° 350 162.4 21.21 140.0 16,100 0° 350 146.	141-2	° C	-67	220.4	18.15	64.7		
0° -67 213.2 19,83 25.0 9,500+ 0° -67 189.7 17.85 51.3 17,100 0° -67 205.7 21.99 37.1 8,900+ 0° -67 213.4 19.56 45.3 12,940 17.9 17.9 15.0 12,940 12,940 0° 72 193.2 19.49 44.8 17,000 0° 72 196.5 20.95 53.6 16,300 0° 72 196.5 19.25 190.6 16,300 0° 72 196.5 20.95 53.6 16,300 0° 72 196.5 19.35 19.60 16,300 0° 72 196.6 19.35 19.60 16,300 0° 72 198.2 19.78 14.80 16,300 0° 350 162.4 21.21 14.80 10,100 0° 350 166.7 24.0	141-4	00	-67	238.1	19.36	48.2	8,700+	evidence of buckling
0° -67 189,7 17.85 51.3 17,100 0° -67 205.7 21.99 37.1 8,900+ 0° 213.4 19.56 45.3 12,940 0° 72 13.2 15.6 45.3 12,940 0° 72 193.2 19.49 44.8 17,000 0° 72 168.5 20.95 53.6 16,300 0° 72 198.2 19.83 212.8 17,000 0° 72 198.2 19.83 212.8 15,300 0° 72 198.2 19.78 16,00 16,00 0° 72 198.2 19.78 16,100 0° 350 162.4 21.21 140.0 16,100 0° 350 146.9 23.91 146.9 5,900 0° 350 146.9 23.91 146.9 5,700 0° 350 146.9 23.91 146.9 <th>141-9</th> <th>0.0</th> <th>-67</th> <th>213.2</th> <th>19,83</th> <th>25.0</th> <th>+005'6</th> <th>evidence of buckling</th>	141-9	0.0	-67	213.2	19,83	25.0	+005'6	evidence of buckling
0° -67 205.7 21.99 37.1 8,900+ evidence of cut dence of cut and c	141-16	٥٥	-67	189,7	17.85	51.3	17,100	
0° 72 19.56 45.3 12,940 0° 72 19.3 1.66 15.0 5,490 0° 72 193.2 19.49 44.8 17,000 0° 72 168.5 20.95 53.6 16,300 0° 72 128.8 19.83 212.8 11,000+ evidence of 0° 72 190.6 19.25 190.6 16,600 16,600 0° 72 190.6 19.25 190.6 16,600 16,600 0° 72 190.6 19.35 190.6 16,600 16,600 0° 72 192.7 19.78 190.6 16,600 16,600 0° 72 192.7 19.78 140.0 16,200 16,400 0° 350 162.4 21.21 146.9 6,200 10.100 0° 350 146.9 23.91 146.9 6,200 10.6 0° 450	141-23	0.0	-67	205.7	21.99	37.1	+006'8	
0° 72 193.2 19.49 4.8 17.000 5.490 0° 72 193.2 19.49 5.4.8 17.000 0° 72 12.8 19.83 212.8 116.004 0 0° 72 190.6 19.25 190.6 16.700 0° 72 190.6 19.25 190.6 16.000 0° 72 190.6 19.25 190.6 16.000 0° 72 190.7 19.78 190.2 190.6 16.1204 0° 350 162.4 21.21 162.4 5.900 0° 350 162.4 21.21 162.4 5.900 0° 350 146.9 23.91 146.9 6.200 0° 350 195.0 23.99 71.1 12.000 0° 450 19.4 21.35 123.3 8,120 0° 450 145.9 20.03 145.9 7,600 0° 450 145.9 20.03 145.9 7,600 0° 450 100.4 23.00 100.4 4,100 0° 450 100.4 23.00 100.4 4.180 0° 450 100.6 20.83 85.5 5.140 0° 56.4 10.06 20.83 85.5 5.140	Avg.			213,4	19.56	45.3	12,940	
0° 72 193.2 19.49 44.8 17,000 0° 72 168.5 20.95 53.6 16,300 16,300 0° 72 122.8 19.25 190.6 19.25 190.6 16,000 0° 72 190.6 19.25 190.5 19.25 190.6 16.00 16.00 0° 72 198.2 19.35 198.2 19.700 16.120+ evidence of 16.00 0° 350 162.4 21.21 162.4 21.21 162.4 5,200 0° 350 162.4 21.21 162.4 5,200 6.200 0° 350 146.9 23.91 146.9 6.200 6.200 0° 350 135.8 24.75 66.5 10,100 6.200 0° 450 146.9 20.03 123.3 4,100 6.200 0° 450 100.4 21.35 27.40 4,600 6.700	Std.Dev.			17.9	1.66	15.0	5,490	
0° 72 193.2 19.49 44.8 17,000 0° 72 168.5 20.95 53.6 16,300 0° 72 212.8 19.23 120.6 16,000 0° 72 190.6 19.25 190.6 16,000 16,000 0° 72 190.6 19.35 198.2 19.00 16,000 16,000 0° 72 190.6 19.35 198.2 199.6 19,00 16,000 0° 72 196.7 19.35 198.2 199.2 19,00 16,000 0° 350 162.7 24.00 160.0 <t< th=""><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th></t<>								
0° 72 168.5 20.95 53.6 16,300 evidence of 0° 72 212.8 19.83 212.8 11,000+ evidence of 0° 72 190.6 19.25 190.6 16,00 16,00 0° 72 198.2 19.35 190.6 19,700 19,700 0° 350 162.7 24.00 162.4 21.21 162.4 5,900 0° 350 162.4 21.21 162.4 5,900 6,200 0° 350 162.4 21.21 162.4 5,900 6,200 0° 350 162.1 23.91 146.9 5,900 6,200 0° 350 162.1 23.91 146.9 5,200 10,100 0° 350 162.1 23.99 123.3 8,120 10,100 0° 450 145.9 7,800 4,100 10,00 10,00 0° 450 100.4 <	141-7	٥٥	72	193.2	19.49	44.8	17,000	
0° 72 212.8 19.83 212.8 11,000+ evidence of evidence of 10.60 0° 72 190.6 19.25 190.6 16,600 16,600 0° 72 198.2 19.35 198.2 19,700 19,700 0° 192.7 19.78 140.0 16,120+ 16,120+ 16,120+ 0° 350 169.7 24.00 169.7 6,400 16,120+ 0° 350 162.4 21.21 162.4 5,900 16.40 0° 350 146.9 23.91 146.9 6,200 10.00 0° 350 135.8 24.75 66.5 10,100 10.100 0° 450 145.9 20.03 145.9 7,800 10.00 0° 450 87.2 50.5 2,760 10.00 10.00 0° 450 100.4 21.35 70.9 4,100 10.00 0° 450 100.4 <td< th=""><th>141-13</th><td>,C</td><td>72</td><td>168,5</td><td>20.95</td><td>53.6</td><td>16,300</td><td></td></td<>	141-13	, C	72	168,5	20.95	53.6	16,300	
0° 72 190.6 19.25 190.6 16,600 0° 72 198.2 19.35 198.2 19,700 0° 192.7 19.78 140.0 16,120+ 0° 350 169.7 24.00 169.7 6,400 0° 350 162.4 21.21 146.9 5,900 0° 350 146.9 23.91 146.9 5,900 0° 350 162.4 21.21 146.9 5,900 0° 350 146.9 23.91 146.9 5,900 0° 350 146.9 23.59 71.1 12,000 0° 350 135.8 24.75 66.5 10,100 0° 450 145.9 20.03 145.9 7,800 0° 450 145.9 20.03 145.9 7,800 0° 450 100.4 23.00 100.4 4,600 0° 450 90.3 22.	141-22	٥ د	72	212.8	19.83	212.8	11,000+	
0° 72 198.2 19.35 198.2 192.7 19.78 140.0 140.0 16.0 0.60 83.3 140.0 0° 350 169.7 24.00 169.7 0° 350 162.4 21.21 162.4 0° 350 146.9 23.09 71.1 0° 350 135.8 24.75 66.5 0° 350 135.8 24.75 66.5 0° 450 145.9 123.39 123.3 0° 450 145.9 20.03 145.9 0° 450 145.9 20.03 145.9 0° 450 87.2 17.28 87.2 0° 450 87.2 17.28 87.2 0° 450 90.3 22.49 23.0 0° 450 90.3 22.49 23.2 0° 450 90.3 22.49 20.8 0°	141-27	0	72	190.6	19.25	190.6	16,600	
0° 192.7 19.78 140.0 16.0 0.60 83.3 16.0 16.0 0.60 83.3 0° 350 169.7 24.00 169.7 0° 350 162.4 21.21 162.4 0° 350 135.8 23.09 71.1 0° 350 135.8 24.75 66.5 7 0° 450 145.9 70.9 70.9 0° 450 145.9 70.9 70.9 0° 450 100.4 23.00 100.4 0° 450 100.4 23.00 100.4 0° 450 100.4 23.00 100.4 0° 450 90.3 22.49 23.50 0° 450 90.3 22.49 23.50 0° 450 90.3 22.49 44.6	141-60	٥,	72	198.2	19,35	198.2	19,700	
0° 16.0 0.60 83.3 0° 350 169.7 24.00 169.7 0° 350 162.4 21.21 162.4 0° 350 146.9 23.91 146.9 0° 350 135.8 24.75 66.5 0° 350 135.8 24.75 66.5 0° 450 145.9 71.1 0° 450 145.9 20.03 145.9 0° 450 19.4 21.35 70.9 0° 450 19.4 23.00 100.4 0° 450 90.3 22.49 23.00 0° 450 90.3 22.49 23.00 0° 450 90.3 22.49 23.5 0° 450 90.3 22.49 23.5 0° 450 90.3 22.49 23.5 0° 450 90.3 22.29 44.6	Avg.			192.7	19.78	140.0	16,1204	
0° 350 169.7 24.00 169.7 0° 350 162.4 21.21 162.4 0° 350 146.9 23.91 146.9 0° 350 195.0 23.09 71.1 0° 350 135.8 24.75 66.5 1 1 152.1 23.39 71.1 1 0° 450 145.9 20.03 145.9 70.5 0° 450 19.4 21.35 70.9 70.9 0° 450 100.4 23.00 100.4 23.2 0° 450 90.3 22.49 23.2 23.2 0° 450 90.3 22.49 23.2 23.2 0° 450 90.3 22.29 44.6 44.6	Std.Dev.			16.0	09.0	83.3	3,170	
0° 350 169.7 24.00 169.7 0° 350 162.4 21.21 162.4 0° 350 146.9 23.91 146.9 0° 350 135.8 24.75 66.5) 0° 350 135.8 24.75 66.5) 162.1 23.39 123.3) 123.3 0° 450 145.9 20.03 145.9 70.9 0° 450 87.2 17.28 87.2 100.4 0° 450 100.4 23.00 100.4 23.2 0° 450 90.3 22.49 23.2 85.5 0° 450 26.4 2.29 44.6 74.6								
0° 350 162.4 21.21 162.4 0° 350 146.9 23.91 146.9 0° 350 135.8 24.75 66.5) 0° 350 135.8 24.75 66.5) 162.1 23.39 123.3) 123.3 0° 450 145.9 20.03 145.9 0° 450 145.9 20.03 145.9 0° 450 87.2 17.28 87.2 0° 450 100.4 23.00 100.4 0° 450 90.3 22.49 23.2 0° 450 90.3 22.49 23.2 0° 450 100.6 20.83 85.5 0° 26.4 2.29 44.6	141-3	0	350	169.7	24.00	1.69.7	6,400	
0° 350 146.9 23.91 146.9 0° 350 135.8 24.75 66.5 1 0° 350 135.8 24.75 66.5 1 162.1 23.39 123.3 1 1 0° 450 145.9 20.03 145.9 1 0° 450 145.9 20.03 145.9 1 0° 450 87.2 17.28 87.2 0 0° 450 100.4 23.00 100.4 23.2 0° 450 90.3 22.49 23.2 23.2 0° 450 100.6 20.83 85.5 100.4 0° 26.4 2.29 44.6 100.6 20.83 144.6	141-11	၁့	350	162.4	21,21	162.4	5,900	
0° 350 195.0 23.09 71.1 0° 350 135.8 24.75 66.5 1 0° 162.1 23.39 123.3 1 0° 450 145.9 20.03 145.9 145.9 0° 450 79.4 21.35 70.9 10.9 0° 450 100.4 23.00 100.4 23.2 0° 450 90.3 22.49 23.2 0° 450 90.3 22.49 23.2 0° 450 90.3 22.49 23.2 0° 450 100.6 20.83 85.5 0° 26.4 2.29 44.6	141-15	0.	350	146.9	23.91	146.9	6,200	
0° 350 135.8 24.75 66.5 7 162.1 23.39 123.3 123.3 123.3 123.3 123.3 123.3 123.3 123.3 123.3 123.3 123.3 123.3 123.3 123.9 123.9 123.3 123.3 123.3 123.2	I41-20	0.	350	195.0	23.09	71.1	12,000	
162.1 23.39 123.3 22.4 1.35 50.5 0° 450 145.9 20.03 145.9 0° 450 79.4 21.35 70.9 0° 450 87.2 17.28 87.2 0° 450 100.4 23.00 100.4 0° 450 90.3 22.49 23.2 0° 450 26.4 2.29 44.6	141-25	0,0	350	135.8	24.75	66.5	10,100	
0° 450 145.9 20.03 145.9 20.03 145.9 70.9 0° 450 79.4 21.35 70.9 70.9 0° 450 87.2 17.28 87.2 87.2 0° 450 100.4 23.00 100.4 23.2 0° 450 90.3 22.49 23.2 23.2 0° 450 100.6 20.83 85.5 44.6	Avg.			162.1	23,39	123.3	8,120	
0° 450 145.9 20.03 145.9 0° 450 79.4 21.35 70.9 0° 450 87.2 17.28 87.2 0° 450 100.4 23.00 100.4 0° 450 90.3 22.49 23.2 20.83 85.5 44.6	Std.Dev.			22.4	1.35	50.5	2,760	
0° 450 145.9 20.03 145.9 0° 450 79.4 21.35 70.9 0° 450 87.2 17.28 87.2 0° 450 100.4 23.00 100.4 0° 450 90.3 22.49 23.2 26.4 2.29 44.6								
0° 450 79.4 21.35 70.9 0° 450 87.2 17.28 87.2 0° 450 100.4 23.00 100.4 0° 450 90.3 22.49 23.2 100.6 20.83 85.5 44.6	141-6	00	450	145.9	20.03	145.9	7,800	
0° 450 87.2 17.28 87.2 0° 450 100.4 23.00 100.4 0° 450 90.3 22.49 23.2 100.6 20.83 85.5 26.4 2.29 44.6	141-8	0.	450	79.4	21.35	6.07	4,100	
0° 450 100.4 23.00 100.4 0° 450 90.3 22.49 23.2 100.6 20.83 85.5 26.4 2.29 44.6	141-12	0.0	450	87.2	17.28	87.2	5,000	
0° 450 90.3 22.49 23.2 100.6 20.83 85.5 26.4 2.29 44.6	141-18	00	450	100,4	23.00	100.4	4,600	
100.6 20.83 85.5 26.4 2.29 44.6	141-24	0	450	90.3	22.49	23.2	4,180	
26,4 2,29 44.6	Avg.			100.6	20.83	85.5	5,140	
	Std.Dev.			26.4	2.29	44.6	1,530	

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					Material:	T300/V378A	
Test: (Compression	sion					
		Test	Ultimate	Initial	Stress at	Ultimate Strain	
Spec.	Fiber	Temp.	Strength (103nsi)	Modulus (10 ⁶ psi)	(10 ³ ps1)	(μ in/in)	Remarks
No.	חדדבווי			60.6	10.1	23,600	
I42-20	90.	-67	54.7	3.63	A 0.5	25.000	
142-24	606	-67	32,4	1.52	34:3	27.500	
142-28	60ء	-67	45.2	3.27	2000	29.500	
142-32	•06	-67	28.2	60.7		11 500+	evidence of buckling
142-36	006	<i>L9-</i>	28.9	2.26	a q	700000	
200			37.9	2.51	16.	7 1 70	
Std. Dev			11.6	1.01	13.4	2076	
						000 30	our dence of buckling or gage fail.
T42-2	.06	72	24.6	2.54	4.5	23 200	
7.42-6	.06	72	28.2	3.86	6.9	201700	
742-10	906	72	28.5	3.09	4.4	207407	
A1-CAT	006	72	24.4	1.97	4.9	24,800	
142-18	306	72	28.1	1.71	7.6	2007.60	
			26.8	2.53	5.9	43,820	
AVG:			2.1	0.87	2.3	0781	
30.00		-					The set hand I had
	000	35.0	17.8	1.41	6.7	15,500+	evidence of bashing
142-40	2	200	8 81	1.61	4.2	13,500	
142-44	e G	320	2007	1.95	4.4	+00879	2000
142-48	906	350	2.02	1.59	3.9	18,100+	evidence of buckling
142-52	906	350	3.4%	36	7.0	15,200	
142-56	06	350	10.3	1 56	5.2	13,820+	
Avg.			73.0	0.26	1.5	4,260	
Std.Dev	•	-	7:3				
						20.800	
142-8	06	450	25.5	1.30	0 3	42.500	
142-12	•06	450	21.0	1.19	0 0	17,900	
142-13	°06	450	17.6	1.19		7 290+	avidence of buckling
142-16	906	450	18.3	1.07	75.3	29, 800	
142-17	°36	450	18.7	1.26	†:°	18.880+	
Ave	_		20.2	1.20	0.0	16.870	
C+d Dev	7.7		3.2	0.09	6.0		
		- The state of the					

Compression	Test Ultimate Initial	(*F) (103psi) (106psi) prop.Lim.	-67 210 0 1.2	18.79 66.1 9900+ evidence	-b/ 253.5 21.41 69.3 13100±	19.34 83.0	225.0 20.33 70.8	-6/ 231.9 29.57 30.0 Leave	223.4 21.89 63.8 1000+ evidence of buckling	4.41 20.0 4500		161.9 17.30 67.5	248.1 21.87	21 02	27.33 62.2 10600	245.0	218 2 25.46 35.7 9500	21.75	2.91 88.9 4000		12.55 111.1 6300+	33.67 64.4 8000+	151.	162.6 26.23 31.5	170 0 19.13 61.0	+	37.1 5.68 30.0 2700		124 2 27 19.12 68.8	105 0	103.0	130 9 25.09 115.9	150 5	22.92
sion	Test		-67		70-	10-	/0	/9-				72	72	72	72	72				260	250	260	260	260				350	350	350	350	350		+
Compres	Fiber	┯╁	.0	00	°C	0.0	000	,				° o s	0	္ပိ	00	00				00	0.0	.0	• 0	00				0 ه	0	00	0.0	0.0		
Test:	Spec.	Ş.	J32-4	J32-8	J32-13	J32-15	J32-21	Avg.	2+0 Dess	1	.132_3	732-2	730 13	737-17	J32-18	J32-25	Avg.	Std.Dev.		J32-1	J32-6	J32-11	J32-17	J32-23	Avg.	Std.Dev.		J32-3	J32-10	J32-16	J32-20	532-27	Avg.	2 7 7 7

The second secon

Fiber Test Ultimate Initial Stress at 100 psi) Corien. (*F) (103psi) (105psi) Corien. (*F) (103psi) (105psi) (1	Test: C	Compression	ilon			Materials	HVE 1076J	
Fiber (°F) Temp. Strength (10 ³ psi) Modulus (10 ³ psi) Prop.Lim. (10 ³ psi) 90° -67 35.5 2.12 7.8 90° -67 32.3 2.18 13.2 90° -67 32.3 2.18 13.2 90° -67 36.0 1.85 9.9 90° -67 26.7 1.61 6.0 90° 72 35.1 1.42 9.9 90° 72 30.8 1.42 12.6 90° 72 30.8 1.42 12.6 90° 72 29.0 1.36 9.5 90° 72 26.7 1.48 2.4 90° 72 26.7 1.48 2.4 50° 26.7 1.52 3.03 4.0 50° 260 22.7 3.03 4.0 50° 260 22.1 1.59 4.5 50° 260 22.3 1.24 4.5			Test	Ultimate	Initial	Stress at		
Orien. (*F) (103psi) (100psi) (103psi) 90° -67 35.5 2.12 7.8 90° -67 32.3 2.18 13.2 90° -67 34.9 1.46 7.5 90° -67 36.0 1.84 9.9 90° -67 26.7 1.84 9.9 90° 72 30.8 1.42 12.6 90° 72 29.0 1.36 9.5 90° 72 30.8 1.48 2.4 90° 72 29.0 1.36 9.5 90° 72 29.0 1.36 12.6 90° 72 29.0 1.46 11.0 90° 72 30.8 1.46 11.0 50° 260 25.7 3.03 4.0 50° 260 22.5 3.03 4.0 50° 260 22.6 1.69 4.5	Spec.	Fiber	Temp.	Strength	Modulus	Prop. Lim.		
90° -67 35.5 2.12 7.8 90° -67 32.3 2.18 13.2 90° -67 44.9 1.46 7.5 90° -67 26.7 1.61 6.0 90° -67 26.7 1.84 9.9 90° 72 31.9 1.73 9.3 90° 72 30.8 1.42 12.6 90° 72 30.8 1.42 12.6 90° 72 30.8 1.42 12.6 90° 72 26.7 1.48 2.4 90° 72 30.8 1.46 11.0 90° 72 30.8 1.66 11.0 50° 260 24.1 1.52 3.8 50° 260 21.5 1.59 4.5 50° 260 21.5 1.59 4.5 50° 260 21.5 1.59 4.5 50° 260 22.6 1.84 4.5 50° 260 22.6 1.84 4.5 50° 260 22.6 1.84 4.5 50° 350 19.4 1.88 3.7 <tr< th=""><th>No.</th><th>Orien.</th><th>(°F)</th><th>(103ps1)</th><th>(10°psi)</th><th>(10³psi)</th><th>(n in/in)</th><th>Remarks</th></tr<>	No.	Orien.	(°F)	(103ps1)	(10°psi)	(10 ³ psi)	(n in/in)	Remarks
90° -67 32.3 2.18 13.2 90° -67 44.9 1.46 7.5 90° -67 36.0 1.85 15.0 90° -67 26.7 1.84 9.9 90° 72 35.1 1.84 9.9 90° 72 30.8 1.42 12.6 90° 72 30.8 1.36 9.5 90° 72 29.0 1.36 9.5 90° 72 30.8 1.46 11.0 50° 72 30.8 1.46 11.0 50° 72 30.8 1.45 12.4 50° 72 30.8 1.45 1.9 50° 260 24.1 1.59 4.5 50° 260 21.5 3.03 4.5 50° 260 22.5 1.84 4.5 50° 260 22.5 1.84 4.5 50° 260 22.6 1.84 4.5 50° 260 22.6 <th>J31-5</th> <th>•06</th> <th>-67</th> <th>35.5</th> <th>2.12</th> <th>7.8</th> <th>13000</th> <th></th>	J31-5	•06	-67	35.5	2.12	7.8	13000	
90° -67 44.9 1.46 7.5 90° -67 36.0 1.85 15.0 90° -67 26.7 1.61 6.0 90° 72 35.1 1.84 9.9 90° 72 30.8 1.42 9.3 90° 72 30.8 1.42 12.6 90° 72 29.0 1.36 9.5 90° 72 20.0 1.36 9.5 90° 72 30.8 1.46 11.0 50° 72 30.8 1.46 11.0 50° 72 30.8 1.46 11.0 50° 260 24.1 1.52 4.5 50° 260 21.5 3.03 4.5 50° 260 21.5 1.84 4.5 50° 260 21.5 1.84 4.5 50° 260 22.5 1.84 4.5 50°	J3118	906	-67	32.3	2.18	13.2	25900	
90° -67 36.0 1.61 6.0 90° -67 26.7 1.61 6.0 90° 72 31.9 1.73 9.3 90° 72 30.8 1.42 12.6 90° 72 29.0 1.36 9.5 90° 72 29.0 1.36 9.5 90° 72 29.0 1.36 9.5 90° 72 29.0 1.36 9.5 90° 72 29.0 1.36 9.5 90° 72 31.4 1.32 12.7 90° 72 31.4 1.32 1.2 50° 260 24.1 1.52 3.8 50° 260 22.3 1.59 4.0 50° 260 22.3 1.59 4.0 50° 260 22.5 1.59 4.0 50° 260 22.5 1.59 4.0 50° 260 22.5 1.69 6.3 50° 260 22.6	J31-22	°06	-67	44.9	1.46	7.5	27400	
90° -67 26.7 1.61 6.0 35.1 1.84 9.9 9.9 6.6 0.31 3.9 3.9 90° 72 31.9 1.73 9.3 90° 72 30.8 1.35 12.6 90° 72 29.0 1.36 9.5 90° 72 26.7 1.48 2.4 90° 72 30.8 1.46 11.0 50° 260 24.1 1.52 3.8 50° 260 25.7 3.03 4.0 50° 260 25.7 3.03 4.0 50° 260 25.7 3.03 4.0 50° 260 25.7 3.03 4.0 50° 260 22.5 1.59 4.5 50° 260 22.5 1.84 4.5 50° 260 22.6 1.84 4.5 60° 260 22.8 1.69 6.3 90° 350 12.4 2.02 3.7 <th>331-33</th> <th>906</th> <th>-67</th> <th>36.0</th> <th>1.85</th> <th>15.0</th> <th>164004</th> <th>puj Jone of buck inc</th>	331-33	906	-67	36.0	1.85	15.0	164004	puj Jone of buck inc
90° 35.1 1.84 9.9 6.6 0.31 3.9 90° 72 31.9 1.73 9.3 90° 72 30.8 1.42 12.6 90° 72 29.0 1.36 9.5 90° 72 26.7 1.48 2.4 90° 72 30.8 1.46 11.0 50° 260 24.1 1.52 3.8 50° 260 25.7 3.03 4.0 50° 260 25.7 3.03 4.0 50° 260 25.7 3.03 4.0 50° 260 25.7 3.23 4.0 50° 260 22.5 1.59 4.5 50° 260 22.5 1.84 4.5 50° 260 22.5 1.69 6.3 50° 350 19.4 1.88 1.0 50° 350 18.7 1.40	J31-49	•06	-67	26.7	1.61	6.0	27700	
90° 72 31.9 1.73 9.3 90° 72 30.8 1.42 12.6 90° 72 29.0 1.36 9.5 90° 72 29.0 1.36 9.5 90° 72 31.4 1.32 12.7 90° 72 31.4 1.32 12.7 50° 260 24.1 1.52 4.0 50° 260 25.7 3.03 4.0 50° 260 25.7 3.03 4.0 50° 260 22.3 1.59 4.5 90° 260 22.5 1.37 4.0 90° 260 22.5 1.84 4.5 90° 350 19.4 1.89 1.0 90° 350 19.4 1.89 3.7 90° 350 18.7 1.40 11.8 90° 350 18.7 1.40 11.8 90° 350 17.3 1.64 7.1 90° 350 19.1 </th <th>Avg.</th> <th></th> <th></th> <th>35.1</th> <th>1.84</th> <th>6.6</th> <th>22100+</th> <th></th>	Avg.			35.1	1.84	6.6	22100+	
90° 72 31.9 1.73 9.3 90° 72 30.8 1.42 12.6 90° 72 29.0 1.36 9.5 90° 72 26.7 1.48 2.4 90° 72 30.8 1.46 11.0 90° 72 30.8 1.46 11.0 50° 260 24.1 1.52 3.8 50° 260 21.5 1.59 4.5 90° 260 22.5 1.84 4.5 50° 260 22.6 1.84 4.5 90° 350 19.4 1.69 6.3 90° 350 19.4 1.88 3.7 90° 350 18.7 1.40 11.8 90° 350 18.7 1.40 11.8 90° 350 19.4 7.1 90° 350 19.1 1.64 7.1 90° 350 19.1 1.64 7.1 90° 350 19.1 1.64 7.1 90° 350 19.1 1.64 7.1 90° 350 19.1 1.64 7.1 90°	Std.Dev.			9.9	0.31	3.9	6400	
90° 72 31.9 1.73 9.3 90° 72 30.8 1.42 12.6 90° 72 29.0 1.36 9.5 90° 72 26.7 1.48 2.4 90° 72 31.4 1.32 12.7 90° 72 31.4 1.32 11.0 50° 260 24.1 1.52 3.03 4.0 50° 260 25.7 3.03 4.0 50° 260 21.5 1.59 4.5 50° 260 21.5 1.59 4.5 50° 260 22.3 1.37 4.0 50° 260 22.6 1.84 4.5 50° 250 19.4 1.69 6.3 90° 350 19.4 1.88 3.7 90° 350 17.4 2.02 3.2 90° 350 18.7 1.40 11.8 90° 350 18.7 1.64 7.1 19.1 1.64 7.1 2.2 0.32 3.7 3.7								
90° 72 30.8 1.42 12.6 90° 72 29.0 1.36 9.5 90° 72 26.7 1.48 2.4 90° 72 31.4 1.32 12.7 90° 72 31.4 1.32 12.7 90° 260 24.1 1.52 3.8 50° 260 24.1 1.52 4.0 50° 260 21.5 1.59 4.5 50° 260 22.3 1.59 4.5 50° 260 22.6 1.84 4.5 90° 350 22.8 1.65 6.3 90° 350 19.4 1.88 3.7 90° 350 17.4 2.02 3.2 90° 350 17.4 2.02 3.2 90° 350 17.3 1.40 11.8 90° 350 17.3 1.25 9.4 19.1 1.64 7.1	J31-19	-06	72	31.9	1.73	9.3	35300	
90° 72 29.0 1.36 9.5 90° 72 26.7 1.48 2.4 90° 72 31.4 1.32 12.7 90° 72 31.4 1.32 12.7 90° 26 24.1 1.52 3.8 50° 260 25.7 3.03 4.0 50° 260 21.5 1.59 4.5 50° 260 22.5 1.59 4.5 50° 260 22.5 1.69 6.3 90° 260 22.6 1.84 4.5 90° 350 22.6 1.69 6.3 90° 350 19.4 1.88 3.7 90° 350 17.4 2.02 3.2 90° 350 17.4 2.02 3.2 90° 350 17.3 1.40 11.8 90° 350 17.3 1.64 7.1 190°	J31-29	06ء	72	30.8	1.42	12.6	46300	
90° 72 26.7 1.48 2.4 90° 72 31.4 1.32 12.7 90° 72 31.4 1.32 12.7 90° 260 24.1 1.52 3.8 3.8 50° 260 24.1 1.52 3.8 4.0 50° 260 21.5 1.59 4.5 4.0 50° 260 22.3 1.37 4.0 6.3 50° 260 22.6 1.84 4.5 1.0 90° 350 19.4 1.69 6.3 1.0 90° 350 19.4 1.65 7.4 90° 350 17.4 2.02 3.2 90° 350 17.4 2.02 3.2 90° 350 17.4 2.02 3.2 90° 350 17.4 2.02 9.4 90° 350 17.4 7.1 19.1 1.64 7.1 19.1 1.54 7.1 19.2 17.3 </td <td>J31-34</td> <td>006</td> <td>72</td> <td>29.0</td> <td>1.36</td> <td>9.5</td> <td>37600</td> <td></td>	J31-34	0 06	72	29.0	1.36	9.5	37600	
90° 72 31.4 1.32 12.7 30.8 1.46 11.0 1.9 50° 260 24.1 1.52 3.8 50° 260 25.7 3.03 4.0 50° 260 21.5 1.59 4.5 50° 260 22.3 1.84 4.5 50° 260 19.4 1.69 6.3 50° 260 19.4 1.69 6.3 90° 350 22.6 1.84 4.5 90° 350 19.4 1.65 7.4 90° 350 17.4 2.02 3.7 90° 350 17.4 2.02 3.7 90° 350 17.4 2.02 3.7 90° 350 17.4 2.02 3.7 90° 350 17.4 2.02 9.4 10° 16.4 7.1 1.64 7.1 10° 19.1 1.64 7.1 10° 19.1 1.54 7.1	J31-43	60ء	72	26.7	1.48	2.4	40067	evidence of buckling
90° 260 24.1 1.52 3.8 50° 260 24.1 1.52 3.8 50° 260 21.5 3.03 4.0 50° 260 21.5 1.59 4.0 50° 260 22.3 1.37 4.0 50° 260 19.4 1.69 6.3 50° 260 19.4 1.69 6.3 90° 350 22.8 1.65 7.4 90° 350 19.4 1.88 3.7 90° 350 19.4 1.88 3.7 90° 350 17.4 2.02 3.2 90° 350 17.3 1.40 11.8 90° 350 17.3 1.25 9.4 90° 350 17.3 1.64 7.1 19.1 1.64 7.1	J31-51	906	72	31.4	1.32	12.7	34400	
90° 260 24.1 1.52 3.8 50° 260 25.7 3.03 4.0 50° 260 21.5 1.59 4.5 50° 260 22.3 1.37 4.0 50° 260 22.3 1.69 6.3 50° 260 19.4 1.69 6.3 90° 350 22.8 1.65 7.4 90° 350 17.4 2.02 3.2 90° 350 17.3 1.40 11.8 90° 350 17.3 1.25 9.4 90° 350 17.3 1.64 7.1	Avg.			30.8	1.46	11.0	32300+	
50° 260 24.1 1.52 3.8 50° 260 25.7 3.03 4.0 50° 260 21.5 1.59 4.5 50° 260 22.3 1.37 4.0 50° 260 22.6 1.69 6.3 90° 350 22.8 1.65 7.4 90° 350 17.4 2.02 3.2 90° 350 17.4 2.02 3.2 90° 350 17.3 1.40 11.8 90° 350 17.3 1.25 9.4 90° 350 17.3 1.64 7.1 19.1 1.64 7.1	Std.Dev.			1.3	0.16	1.9	14400	
90° 260 24.1 1.52 3.8 90° 260 25.7 3.03 4.0 90° 260 21.5 1.59 4.5 90° 260 22.3 1.69 6.3 90° 350 22.6 1.84 4.5 90° 350 22.8 1.65 7.4 90° 350 17.4 2.02 3.2 90° 350 17.4 2.02 3.2 90° 350 17.3 1.40 11.8 90° 350 17.3 1.25 9.4 90° 350 17.3 1.64 7.1 90° 350 17.3 1.64 7.1								
50° 260 25.7 3.03 4.0 \$0° 260 21.5 1.59 4.5 \$0° 260 22.3 1.37 4.0 \$0° 260 19.4 1.69 6.3 \$0° 22.6 1.84 4.5 \$0° 350 22.8 1.65 7.4 \$0° 350 19.4 1.88 3.7 \$0° 350 17.4 2.02 3.2 \$0° 350 17.3 1.40 11.8 \$0° 350 17.3 1.25 9.4 \$0° 350 17.3 1.64 7.1 \$0° 350 17.3 1.64 7.1	J31-9	°05	260	24.1	1.52	3.8	13800	
\$10° 260 21.5 1.59 4.5 \$0° 260 22.3 1.37 4.0 \$0° 260 19.4 1.69 6.3 \$0° 22.6 1.84 4.5 \$0° 350 2.4 0.68 1.0 \$90° 350 22.8 1.65 7.4 \$90° 350 17.4 2.02 3.2 \$90° 350 18.7 1.40 11.8 \$90° 350 17.3 1.25 9.4 \$90° 350 17.3 1.64 7.1 \$90° 350 17.3 1.64 7.1	J31-21	5،0 ه	260	25.7	3.03	4.0		gage failed
90° 260 22.3 1.37 4.0 90° 260 19.4 1.69 6.3 22.6 1.84 4.5 2.4 0.68 1.0 90° 350 22.8 1.65 7.4 90° 350 19.4 1.88 3.7 90° 350 17.4 2.02 3.2 90° 350 17.3 1.40 11.8 90° 350 17.3 1.25 9.4 19.1 1.64 7.1 2.2 0.32 3.7	331-31	\$ 05	260	21.5	1.59	4.5	***	gage failed
90° 260 19.4 1.69 6.3 22.6 1.84 4.5 2.4 0.68 1.0 90° 350 22.8 1.65 7.4 90° 350 19.4 1.88 3.7 90° 350 17.4 2.02 3.2 90° 350 17.3 1.40 11.8 90° 350 17.3 1.25 9.4 19.1 1.64 7.1 2.2 0.32 3.7	J31-46	06ء	260	22.3	1.37	4.0	21400	
22.6 1.84 4.5 2.4 0.68 1.0 90° 350 22.8 1.65 7.4 90° 350 19.4 1.88 3.7 90° 350 17.4 2.02 3.2 90° 350 18.7 1.40 11.8 90° 350 17.3 1.25 9.4 19.1 1.64 7.1 2.2 0.32 3.7	331-55	906	260	19.4	1.69	6,3	9600+	evidence of buckling
90° 350 22.8 1.65 7.4 90° 350 19.4 1.88 3.7 90° 350 17.4 2.02 3.2 90° 350 18.7 1.40 11.8 90° 350 17.3 1.25 9.4 19.1 1.64 7.1 2.2 0.32 3.7	Avq.			22.6	1.84	4.5	17600*	*excludes J31-55
90° 350 22.8 1.65 7.4 2 90° 350 19.4 1.88 3.7 2 90° 350 17.4 2.02 3.2 90° 350 17.3 1.25 9.4 1 90° 350 17.1 1 1.64 7.1 1 2.2 0.32 3.7	Std.Dev.			2.4	0.68	1.0		
90° 350 22.8 1.65 7.4 2 90° 350 19.4 1.88 3.7 90° 350 17.4 2.02 3.2 90° 350 18.7 1.40 11.8 2 90° 350 17.3 1.25 9.4 1 2.2 0.32 3.7								
90° 350 19.4 1.88 3.7 90° 350 17.4 2.02 3.2 90° 350 18.7 1.40 11.8 2 90° 350 17.3 1.25 9.4 1 19.1 1.64 7.1 1 2.2 0.32 3.7	J31-2	• 06	350	22.8			21300	
90° 350 17.4 2.02 3.2 90° 350 18.7 1.40 11.8 2 90° 350 17.3 1.25 9.4 1 19.1 1.64 7.1 1 2.2 0.32 3.7	J31-15	•06	350	19.4	1.88	3.7	7700+	evidence of buckling
90° 350 18.7 1.40 11.8 2 90° 350 17.3 1.25 9.4 1 2.2 0.32 3.7	J31-23	•06	350	17.4	2.02	3.2	+0069	evidence of buckling
90° 350 17.3 1.25 9.4 19.1 1.64 7.1 2.2 0.32 3.7	J31-39	. 06	350	18.7	1.40	11.8	20000	
19.1 1.64 7.1 2.2 0.32 3.7	J31-50	•06	350	17.3	1.25	9.4	15300+	evidence of buckling
2.2 0.32 3.7	Avg.			19.1	1.64	7.1	14200+	
	Std.Dev.	T		2.2	0.32	3.7	6700	

and the second s

	Crearing			Material:	G-160/6535-1	
Fiber	Test Temp.	Ultimate Strength	Initial Modylus	Stress at Prop.Lim.		
Orten.	(*F)	(103psi)	(10°psi)	(10 ³ psi)	(n in/in)	Remarks
00	-67	230.8	19.26	63.95	11,850	
°	-67	192.4	22.02	72.55	8,400	
°	-67	235.4	21.13	69.86	10,100+	Evidence of buckling
0.0	-67	193.0	20,16	96,98	6.400+	*
°O	-67	213.6	20.14	76.10	10,850+	Evidence of buckling
		214.0	20.54	73.88	9,520+	
		19.1	1.06	8.55	2,200	
°	72	209.6	17.09	88.5	14,200	and and the second and and the second se
ô	72	216.7	20.83	156.6	15,500	
å	72	207.2	19.51	122.4	8.600+	Evidence of buckling
ဝိ	72	204.0	19.28	0.06	19,000	
°	72	223.9	19.32	73.9	16,700	and sections of the control of the c
		212.3	19.21	106.3	14,800+	of the second
		8.0	1.34	33.2	3,890	
ô	260	192.3	18.76	***************************************	9,100+	Evidence of buckling
°	260	206.3	19.84	75.0	12,100	
ô	260	184.8	19.16	95.8	13,700	
ô	260	204.3	19.76	1 4 1	+008'6	Evidence of buckling
0	260	156.5	16.10	71.7	10,600	anderson bester families of exercise of applications are provided for plantam. The translation of order provided in the contraction of the contrac
		188.8	18.73	60.9	11,060+	er de la completa del la completa de la completa del la completa de la completa de la completa del la complet
		20.1	1.53	13.1	1,850	Andrew State of the State of th
ô	350	152.0	18.18	88.9	009'6	
٥	350	163.0	23.13	132.8	8,500	
0,0	350	135.4	22.30	94.0	8,200	offengine declaration configurations of the configuration of the configu
0.0	350	145.8	23.90	75.5	7,000	
°O	350	160.7	19.51	118.4	9,350	
		151.4	21.40	101.9	8,530	
		11.3	2.45	23.2	1,030	

Test.	Compression	aton			Matorial .	F 30 307 00 F 0	and manufacturing special standards to address of the special standards by special standards and special stand
I	2				· TAT TOTAL	T-CFCQ/DOT-S	a de la companya de l
(:	Test	Ultimate	Initial	Stress at	5	
Spec.	Fiber Grien.	Temp.	Strength $(10^3 psi)$	Modulus (10 ⁵ psi)	Prop.Lim. $(10^{3}psi)$	Strain (p in/in)	Remarks
K19-3	•06	-67	32.7	1.88	8.6	32,600	
K19-25	60ء	-67	39.3	2.06	18.8	22.800+	Evidence of buckling
K19-41	06،	-67	33.4	2.21	10.7	23,200	
K4:4-4	06،	-67	29.7	2.09	13.6	20,000+	Evidence of buckling
K44-27	06،	-67	45.5	1.81	17.3	30,050+	Evidence of buckling
Avg.			36.1	2.01	14.1	25,730+	
Std.Dev.			6.3	0.16	4.0	5,330	
K19-5	906	72	30.2	1.57	15.5	25,800	
K19-27	, 06	72	22.6	1.91	11.8	7,200+	Evidence of buckling
K19-45	, 06	72	30.2	2.02	12.5	36,000	
K44-1	06،	72	27.0	2.64	12.1	8,600+	Evidence of buckling
K44-22	900	72	25.0		14.0	32,200	
Avg.			27.0	2.04	13.2	21,960+	
Std.Lev.			3.3	0.45	1.5	13,350	
K19-1	906	260	25.4	1.42	20.2	14,600+	Evidence of buckling
E19-11	90,	260	24.2	i.43	15.5	13,700+	Evidence of buckling
K19-40	906	260	22.0	1.33	14.3	26,300	
K44-3	°06	260	23.7	1.29	12.9	12,800+	Evidence of buckling
K44-25	•06	260	24.5	1.56	16.5	10,900+	Evidence of buckling
Avg.			24.0	1.40	15.9	15,660+	
Std.Dev.			1.3	0.10	2.8	6,100	
K19-4	•06	350	19.8	1.87	11.9	17,000+	Evidence of buckling
K19-26	06ء	350	26.3	2.12	10.4	14,800	
K19-42	90ء	350	19.0	2.19	14.3	7,000+	Evidence of buckling
K44-2	206	350	16.6	1.63	10.7	7,230+	Evidence of buckling
K44-23	•06	350	17.1	1.21	9.6	12,700+	Evidence of buckling
Avg.			19.8	1.80	11.4	11,750+	
Std.Dev.			3.9	0.40	1.9	4,490	

APPENDIX F FLEXURE DATA

All of the flexure data generated during this program are listed in this appendix. Summaries of these data are tabulated in Sections 4.1 through 4.6.

	exure			L/D Ratio:	32:1
Materials	: T300/	AFR300	·	,	
Specimen Number	Fiber Orien- tation	Test Temp. (°F)	Ultimate Strength (ksi)	Modulus of Elasticity (10 ⁶ psi)	
F19-5	00	-67	299.7	21.24	4 pt./tensile failure
F19-8	00	-67	291.5	20.59	on lower surface
F19-12	00	-67	295.9	19.77	
F19-15	00	-67	292.6	20.73	
F20-3	. 00	-67	278.1	18.24	
Avg.			291.6	20.11	
Std. Dev.			8.2	1.17	
F19-2	00	72	282.0	21.68	4 pt./tensile failure
F19-7	00	72	280.2	20.69	on lower surface
F19-17	00	72	272.9	20.56	
F19-20	00	72	284.9	20.94	
F20-6	00	72	230.7	19.63	
Avg.			280.1	20.70	
Std. Dev.			4.4	0.74	
F19-0	00	260	182.4	15.23	3 pt./specimens
F19-10	೦೦	260	225.8	17.18	snapped in half
F19-22	00	260	202.5	16.11	
F20-1	00	260	248.6	19.18	
Avq.			214.8	16.92	
Std.Dev.			28.7	1.70	
F19-14	00	260	206.5	20.22	4 pt./delamination
F19-16	00	260	206.8	21.06	failures
F19-19	00	260	230.0	20.99	
F19-23	00	260	224.8	21.27	
F19-24	00	260	223.1	20.57	
Avg.			218.2	20.82	Shear stress at
Std.Dev.			10.9	0.42	failure = 6890 psi

	exure	···········		L/D Ratio:	32:1
Materials	: T300/	AFR800			
Specimen Number	Fiber Orien- tation	Test Temp. (°F)	Ultimate Strength (ksi)	Modulus of Elasticity (10 ⁶ psi)	
F19-1	00	350	184.0	16.72	3 pt./Compr.
F19-11	0°	350	162.6	17.05	3 pt./Compr.&Delam
F19-13	00	350	167.2	17.23	3 pt./Compr.
F19-21	0°	350	168.4	17.40	3 pt./Compr.
F20-4	o°	350	181.1	17.72	3 pt./Compr.&Delam
Avg.			172.7	17.22	shear stress at
Std. Dev.			9.3	0.37	failure = 2560 psi
F19-3	00	350	181.5	19.70	4 pt./delamination
F19-9	00	350	187.3	20.16	failures
F19-18	00	350	181.3	19.74	_
F20-2	00	350	192.5	20.06	
F20-5	00	350	191.5	20.05	Į.
Avg.			186.8	19.94	shear stress at
Std.Dev.			5.3	0.21	failure = 5880 psi
the second secon					

	exure		L/D Ratio: 32:1		
Materials	: T300/	AFR800			
Specimen Number	Fiber Orien- tation	Test Temp. (°F)	Ultimate Strength (光si)	Modulus of Elasticity (10 ⁶ psi)	Remarks
F19-4	900	-67	13.98		4 pt. loading
F20-5	90°	-67	17.71	1.70	
F20-15	900	-67	13.02	1.73	
F20-19	900	-67	15.03	1.59	
F20-26	90°	-67	14.76	1.64	
Avq.			14.90	1.67	
Std.Dev.			1.75	0.06	
F19-2	900	72	14.43	1.34	4 pt. loading
F20-4	900	72	14.15	1.24	
F20-12	90°	72	13.57	1.25	
F20-20	90°	72	13.95	1.26	
F20-24	900	72	14.42	1.24	
Avg.			14.10	1.27	
Std.Dev.			0.36	0.04	
F19-5	900	260	10.42	1.09	4 pt. loading
F20-8	900	260	10.83	1.14	
F20-13	900	260	10.21	1.18	
F20-17	90°	260	11.21	1.26	
F20-23	900	260	10.70	1.18	
Avg.			10.68	1.17	
Std. Dev.			0.44	0.07	
F19-1	900	350	11.12	1.09	4 pt. loading
F19-6	900	350	9.68	1.02	
F20-10	90°	350	11.75	1.22	
F20-18	900	350	12.80	1.16	
F20-25	90°	250	10.68	1.17	
Avg.			11.21	1.13	
Std. Dev.			1.31	0.08	

Test: Fl		- 7		L/D Ratio:	32:1
Materials Specimen Number	Fiber Orien- tation	Test Temp.	Ultimate Strength (ksi)	Modulus of Elasticity (10 ⁶ psi)	
7.4 HT. B. L.	00	-67	318.7	31.42	4 pt./tensile failure
G20-5	0°	-67	317.9	32.41	on lower surface
G20-11	00	-67	333.3	31.42	
G20-16 G20-20	00	-67	318.7	32.42	
G20-24	00	-67	324.7	31.72	
G20-24 G20-28	00	-67	336.4	33.14	
Avg.			324.9	31.92	*
			8.1	0.71	
Std. Dev.			0.1	3.72	
G20-4	00	72	316.3	32.04	4 pt./tensile failure
G20-8	00	72	298.0	31.29	on lower surface
G20-17	00	72	324.1	32.98	
G20-22	00	72	313.5	31.35	
G20-23	00	72	320.8	32.42	
Avg.		2	314.6	31.82	V
Std. Dev.			10.1	0.48	
G20-7	00	260	187.6	30.00	4 pt./shear failure
G20-14	00	260	166.1	28.44	
G20-19	00	260	171.4	29.61	
G20-21	o°	260	204.1	29.00	
G20-27	00	260	217.2	30.89	
Avq.			189.3	29.59	Shear stress at
Std. Dev.			21.6	0.94	failure = 5900 psi
				-	
			 		
			1		
		1			

Fiber Orien- tation	Test Temp.	Ultimate	Modulus of	
Orien- tation		Ultimate	Moduline of	
آ م	(°F')	Strength (ksi)	Elasticity (106psi)	Remarks
00	350	109.9	32.22	4 pt/shear failure
o°	350	118.0	29.11	
0°	350	121.5	31.23	
0°	350	124.7	31.42	
o°	350	126.2	27.83	
		1.20.0	30.36	Shear stress at
		6.5	1.82	failure = 3750 psi
00	260	322.6	28.87	3 pt/tensile failure
o°	260	308.7	28.67	on lower surface
00	260	322.9	30.23	
00	260	312.4	28.07	
		316.7	28.96	
		. 7.2	0.91	
00	350	170.1	24.00	3 pt/shear failure
0°	35C	182.9	25.70	
o°	350	173.8	24.04	
o°	350	175.2	24.56	
		175.5	24.58	Shear stress at
		5.4	0.79	failure = 2770 psi
90 ົ	-67	17.3	2.85	4 pt. loading
900	-67	17.3	2.62	
900	-67	14.9	2.58	
900	-67	14.6	2.95	
900	-67	15.2	2.54	
		15.9	2.71	
		1.3	0.18	
	0° 0° 0° 0° 0° 0° 0° 0° 0° 0° 90° 90°	0° 350 0° 350 0° 260 0° 260 0° 260 0° 260 0° 350 0° 350 0° 350 0° 350 0° 350 0° 67	0° 350 124.7 0° 350 126.2 120.0 6.5 0° 260 322.6 0° 260 308.7 0° 260 322.9 0° 260 312.4 316.7 7.2 0° 350 170.1 0° 350 173.8 0° 350 175.2 175.5 5.4 50° -67 17.3 90° -67 17.3 90° -67 14.9 90° -67 14.6 90° -67 15.2 15.9 15.9	0° 350 124.7 31.42 0° 350 126.2 27.83 120.0 30.36 6.5 1.82 0° 260 322.6 28.87 0° 260 308.7 28.67 0° 260 322.9 30.23 0° 260 312.4 28.97 316.7 28.96 7.2 0.91 0° 350 170.1 24.00 0° 350 170.1 24.00 0° 350 173.8 24.04 0° 350 175.2 24.56 175.5 24.58 5.4 0.79 90° -67 17.3 2.85 90° -67 17.3 2.62 90° -67 14.9 2.58 90° -67 14.6 2.95 90° -67 15.2 2.54 15.9 2.71

Test: Fl	exure		L/D Ratio: 32:1		
Materials	: SIC/5	506			
Specimen Number	Fiber Orien- tation	Test Temp. (°F)	Ultimate Strength (ksi)	Modulus of Elasticity (10 ⁶ psi)	Remarks
G21-1	90°	72	14.9	2.52	4 pt. loading
G21-5	90°	72	15.5	2.44	
G21-10	90°	72	13.5	2.31	
G21-15	90°	72	15.0	2.23	
G21-20	90°	72	14.3	2.17	
G21-25	90°	72	13.9	2.39	L
Avg.			14.5	2.34	
Std.Dev.			0.8	0.13	
G21-2	900	260	10.0	1.18	4 pt. loading
G21-8	900	260	10.3	1.57	
G21-16	90°	260	10.4	1.34	
G21-24	900	260	11.6	1.50	
G21-28	900	260	13.2	1.62	
Avg.			11.1	1.44	Y
Std.Dev.			1.4	0.18	
G21-4	900	350	6.7	0.86	4 pt. loading
G21-6	900	350	6.9	0.85	
G21-12	900	350	7.7	0.89	
G21-21	900	350	7.4	0.84	
G21-27	900	350	6.1	0.82	
Avg.			7.0	0.85	
Std.Dev.			0.6	0.03	
G37-1	900	350	8.2	0.93	3 pt. loading
G37-2	900	350	11.3	1.13	
G37-3	900	350	8.9	0.96	
G37-4	200	350	11.1	1.12	
Avg.			9.9	1.03	w(\$=\p\117\
Std.Dev.			1.6	0.11	

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Test: Flo Materials	exure	45	L/D Ratio:	32:1	
Specimen Number	Fiber Orien- tation	Test Temp. (°F)	Ultimate Strength (ksi)	Modulus of Elasticity (10 ⁶ psi)	Remarks
H8 − 5	0°	-67	96.1	37.92	4 pt. loading
H8-16	0°	-67	107.1	42.31	
н8-19	0°	-67	62.2	23.14	
н8-26	0°	-67	87.1	44.66	
H8-3	0°	-67	103.8	43.71	
н8-15	0°	-67	77.0	20.18	
Avg.			88.9	35.32	
Stđ.Dev.			17.1	10.87	
н8~10	0°	72	91.9	39.37	4 pt. loading
н8-13	0°	72	89.7	41.07	
н8-17	0°	72	91.9	41.62	
н8-21	0°	72	87.4	41.84	
H8-24	0°	72	90.2	43.87	Ţ
A v g.			90.2	41.55	
Std.Dev.			1.9	1.62	
H8-14	0°	260	65.9	41.40	4 pt. loading
н8-18	0°	260	68.7	41.80	
H8-20	0°	260	62.8	20.70	
н8-22	o°	260	69.0	44.01	
н8-23	0°	260	66.7	39.60	
Avg.			56.6	37.50	
Std.Dev.			2.5	9.52	
н8-4_	0°	350	63.3	37.49	4 pt. loading
н8-6	0°	350	64.5	45.36	
н8-11	0°	350	66'.7	39.16	
н6-12	0°	350	70.0	40.81	
H8-25	0°	350	69.9	39.47	
Avg.			66.9	40.46	
Std.Dev.			3.0	2.98	

* 11 °

	exure		L/D Ratio: 32:1			
Materials	HyE 203	34D				
Specimen Number	Fiber Orien- tation	Test Temp. (°F)	Ultimate Strength (ksi)	Modulus of Elasticity (106psi)	Remarks	
H9-1	90°	-67	5.54	1.04	4 pt. loading	
н99	90 °	-67	5.75	1.08		
н9-19	90°	~67	5.54	1.13		
н9-22	90°	-67	5.28	1.04		
н9-24	90°	- 67	5.75	1.04		
Avg.			5.57	1.07		
Std. Dev.			0.19	0.04		
770-3	90°	72	5.72	1.00	4 pt. loading	
н9-3 н9-6	90.	72	5.72	1.17	- pc. roading	
				1.08		
н9-15 н9-16	90°	72	5.57 4.80	1.08		
· · · · · · · · · · · · · · · · · · ·			 	1.12		
H9-20	90°	72	5.31	1.09	<u> </u>	
Avg.			0.37	0.06		
Std. Dev.			0.37	3.50		
н9-4	90°	260	3.78	0.91	4 pt. loading	
н9-5	90°	260	3.78	0.87		
н9-8	90°	260	3.65	0.86		
н9-10	90°	260	3.38	0.91		
н9-11	90°	260	3.78	0.95	•	
Avg.			3.67	0.90		
Std. Dev.			0.17	0.04		
н9-12	90°	350	2.72	0.75	4 pt. loading	
н9-7	90°	3 50	2.93	0.76		
н9-13	90°	350	2.65	0.80		
н9-14	90°	350	2.51	0.80		
н9-17	90°	350	3.20	0.76		
Avg.			2.80	0.77		
Std. Dev.			0.27	0.02	-11	

Test: Fl				L/D Ratio:	32:1	
Materials	T300 /	/V378A				
Specimen Number	Fiber Orien- tation	Test Temp. (°F)	Ultimate Strength (bsi)	Modulus of Elasticity (10 ⁶ psi)		
11-6	00	-67	289.4	1708	3 pt/tensile failure	
11-13	o°	-67	276.3	16.13	on lower surface	
11-15	00	-67	262.1	15.50		
11-24	00	-67	277.4	15.94		
11-26	0°	-67	248.4	15.38		
Avg.			270.7	16.01		
Std.Dev.			15.8	0.67		
11-5	0°	72	224.4	16.94	4 pt/mixed failure	
I1-7	0°	72	232.3	15.81	modes. Some delamina-	
11-10	o°	72	220.1	19.19	tion; some tension on	
I1-17	o°	7.2	219.5	16.94	lower surface; some	
I1-23	0°	72	226.3	16.94	comp. under upper loading r	ose
Avg.			224.6	17.16	Shear stress at	
Std.Dev.			5.2	1.24	failure = 7010 psi.	
r1-4	00	350	166.6	16.89	4 pt/delamination fail	
11-11	00	350	156.5	15.66		
Avg.			161.6	16.28	Shear stress at fail = 5040 psi	
11-16	00	350	163.4	15.36	3 pt/mixed failure	
11-19	00	350	175.4	16.32	modes. Some tension	
11-22	0°	350	172.8	15.18	on lower surface; some	
Avg.			170.5	15.62	compression on upper	
Std.Dev.			6.3	0.61	surface.	
	 					
	 					
		ļ				
		<u> </u>				

32:1 L/D Ratio: Test: Plexure Materials: T300/V378A **Fiber** Ultimate Modulus of Test Strength Elasticity Specimen Orien-Temp. (106psi)Number tation (°F) (ksi) Remarks 00 16.67 450 172.8 tension on bottom 11-2 oo 16.23 compression on top 176.1 11-9 450 00 15.24 [compressive failure 157.3 I1-12 450 00 450 157.7 16.45 on upper surface **I1-14** υŏ 450 156.5 15.82 11-21 164.1 16.08 Agv. Std.Dev. 9.5 0.57

3 pt.

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	exure			L/D Ratio:	32:1
Materials	7	V378A	Y		
Specimen Number	Fiber Orien- tation	Test Temp. (°F)	Ultimate Strength (ksi)	Modulus of Elasticity (10 ⁶ psi)	Remarks
12-2	90°	-67	10.40	1.81	4 pt. loading
12-6	90°	-67	9.40	1.77	
12-14	90°	-67	12.22	1.94	
12-20	90°	~67	9.51	1.68	
12-24	900	-67	14.38	1.91	Į.
Avg.			11.18	1.82	
Std.Dev.			2.12	0.11	
12-1	900	72	10.88	1.79	4 pt. loading
12-7	900	72	12.35	1.79	
12-11	900	72	12.14	1.74	
I2-18	900	72	10.33	1.69	
12-26	900	72	12.20	1.68	
Avg.			11,58	1.74	
Std.Dev.			0.91	0.05	
12-3	900	350	6.92	1.37	4 pt. loading
12-8	900	350	7.45	1.49	
12-15	900	350	8.68	1.50	
12-21	900	350	9.80	1.53	
12-25	900	350	9,13	1.47	
Avg.			8.39	1.47	
Std.Dev.			1.19	0.06	
I2-4	90°	450	8.00	1.24	4 pt. loading
12-12	900	450	7.57	1.37	
12-17	900	450	8.52	1.28	
12-19	900	450	7.07	1.15	
12-23	900	450	8.03	1.38	
Avg.			7.84	1.29	
Std.Dev.			0.54	0.09	

J2-11 0° -67 263.8 18.62 J2-16 0° -67 239.3 18.83 J2-20 0° -67 276.3 18.81 J2-23 0° -67 261.3 17.50 J2-23 0° -67 261.9 18.62 <td< th=""><th>Test: Fl</th><th>exure</th><th><u> </u></th><th></th><th>L/D Ratio:</th><th>32:1</th></td<>	Test: Fl	exure	<u> </u>		L/D Ratio:	32:1
Specimen Orien Number Corp. Number Corp.	Materials	: HyE 10	76J			
J2-11 0° -67 263.8 18.62 18.83 J2-16 0° -67 239.3 18.83 18.83 J2-20 0° -67 276.3 16.81 17.50 J2-23 0° -67 261.3 17.50 Avg. 261.9 18.62 18.62 Std. Dev. 13.9 0.68 18.62 J2-2 0° 72 189.7 13.84 pt./tensile failurestending failure	_	Orien-	Temp.	Strength	Elasticity	
J2-16 0° -67 239.3 18.83 J2-20 0° -67 276.3 18.81 J2-23 0° -67 261.3 17.50	J2-4	0.	-67	268.9	19.35	3 pt./tensile failure
J2-20 0° -67 276.3 18.81 J2-23 0° -67 261.3 17.50 Avg. 261.9 18.62 Std. Dev. 13.9 0.68 J2-2 0° 72 186.3 14.57 4 pt./tensile failurents J2-7 0° 72 189.7 13.84 18.81 19.7 13.84 19.7 19.84 19.7 19.84 19.7 19.84 19.7 19.84 19.7 19.84 19.84 19.84 19.84 19.84 19.84 19.84 19.94 19.94 19.94 19.97 <t< td=""><td>J2-11</td><td>0°</td><td>-67</td><td>263.8</td><td>18.62</td><td></td></t<>	J2-11	0°	-67	263.8	18.62	
J2-23 0° -67 261.3 17.50 Avg. 261.9 18.62 Std. Dev. 13.9 0.68 J2-2 0° 72 186.3 14.57 4 pt./tensile failur J2-7 0° 72 189.7 13.84 18.97 13.84 19.1 19.1 15.21 19.1 <	J2-16	0.	-67	239.3	18.83	
Avg. 261.9 18.62 Std. Dev. 13.9 0.68 J2-2 0° 72 186.3 14.57 4 pt./tensile failure J2-7 0° 72 189.7 13.84 18.62 18	J2-20	0°	-67	276.3	18.81	
J2-2 0° 72 186.3 14.57 4 pt./tensile failur J2-7 0° 72 189.7 13.84	ј2-23	0.0	-67	261.3	17.50	
J2-2 0° 72 186.3 14.57 4 pt./tensile failu J2-7 0° 72 189.7 13.84	Avg.			261.9	18.62	
J2-7 0° 72 189.7 13.84	Std. Dev.			13.9	0.68	
J2-7 0° 72 189.7 13.84						
J2-9 0° 72 191.4 15.21 J2-17 0° 72 187.5 15.37 J2-22 0° 72 195.8 15.29 Avg. 190.1 14.86 Std. Dev. 3.6 0.65 J2-5 0° 260 152.1 13.74 Note: primary failure J2-8 0° 260 149.4 12.97 in compression(4 pt J2-13 0° 260 148.1 12.02 12.57 J2-18 0° 260 158.2 12.57 13.97 tension failure/4 pt Avg. 156.8 13.05 13.05 156.8 13.05 Std. Dev. 11.5 0.81 0.81 17.08 shear failure/4 pt J2-3 0° 350 145.7 17.08 shear failure/4 pt J2.12 0° 350 183.3 19.07 19.43 3 pt./compression failure/4	J2-2	0.0	72	186.3	14.57	4 pt./tensile failure
J2-17 0° 72 187.5 15.37 J2-22 0° 72 195.8 15.29 Avg. 190.1 14.86 Std. Dev. 3.6 0.65 J2-5 0° 260 152.1 13.74 Note: primary failurely fa	J2-7	0°	72	189.7	13.84	
J2-22 0° 72 195.8 15.29 Avg. 190.1 14.86 Std. Dev. 3.6 0.65 J2-5 0° 260 152.1 13.74 Note: primary failure J2-8 0° 260 149.4 12.97 in compression(4 pt J2-13 0° 260 148.1 12.02 12.57 J2-18 0° 260 158.2 12.57 13.97 tension failure/4 pt Avg. 156.8 13.05 13.05 156.8 13.05 Std. Dev. 11.5 0.81 0.81 J2-3 0° 350 145.7 17.08 shear failure/4 pt J2-10 0° 350 178.0 19.43 3 pt./compression failure/4 J2-12 0° 350 183.3 19.07 19.07	J2-9	0.0	72	191.4	15.21	
Avg. 190.1 14.86 Std. Dev. 3.6 0.65 J2-5 0° 260 152.1 13.74 Note: primary failure J2-8 0° 260 149.4 12.97 in compression(4 pt J2-13 0° 260 148.1 12.02 12.57 J2-18 0° 260 158.2 12.57 13.97 tension failure/4 pt Avg. 156.8 13.05 13.05 13.05 13.05 Std. Dev. 11.5 0.81 0.81 0.81 0.81 J2-3 0° 350 145.7 17.08 shear failure/4 pt 13.05 19.43 3 pt./compression failure/4 pt J2-12 0° 350 178.0 19.43 3 pt./compression failure/4 pt	J2-17	0°	72	187.5	15.37	
Std. Dev. 3.6 0.65 J2-5 0° 260 152.1 13.74 Note: primary failure fai	J2-22	0°	72	195.8	15.29	J.
J2-5 0° 260 152.1 13.74 Note: primary failure failur	Avg.			190.1	14.86	
J2-8 0° 260 149.4 12.97 in compression(4 pt J2-13 0° 260 148.1 12.02 J2-18 0° 260 158.2 12.57 J2-21 0° 260 176.2 13.97 tension failure/4 pt Avg. 156.8 13.05 Std. Dev. 11.5 0.81 J2-3 0° 350 145.7 17.08 shear failure/4 pt J2-10 0° 350 178.0 19.43 3 pt./compression failure/4 pt J2-12 0° 350 183.3 19.07	Std. Dev.			3.6	0.65	
J2-8 0° 260 149.4 12.97 in compression(4 pt J2-13 0° 260 148.1 12.02 J2-18 0° 260 158.2 12.57 J2-21 0° 260 176.2 13.97 tension failure/4 pt Avg. 156.8 13.05 Std. Dev. 11.5 0.81 J2-3 0° 350 145.7 17.08 shear failure/4 pt J2-10 0° 350 178.0 19.43 3 pt./compression failure/4 pt J2-12 0° 350 183.3 19.07						
J2-13 0° 260 148.1 12.02 J2-18 0° 260 158.2 12.57 J2-21 0° 260 176.2 13.97 tension failure/4 pt. Avg. 156.8 13.05 Std. Dev. 11.5 0.81 J2-3 0° 350 145.7 17.08 shear failure/4 pt. J2-10 0° 350 178.0 19.43 3 pt./compression for the state of the state o	J2- 5	0.	260	152.1	13.74	Note: primary failure
J2-13 0° 260 148.1 12.02 J2-18 0° 260 158.2 12.57 J2-21 0° 260 176.2 13.97 tension failure/4 pt Avg. 156.8 13.05 Std. Dev. 11.5 0.81 J2-3 0° 350 145.7 17.08 shear failure/4 pt J2-10 0° 350 178.0 19.43 3 pt./compression failure/4 pt J2-12 0° 350 183.3 19.07 19.07	J2-8	0.0	260	149.4	12.97	in compression(4 pt.)
J2-21 0° 260 176.2 13.97 tension failure/4 property Avg. 156.8 13.05 Std. Dev. 11.5 0.81 J2-3 0° 350 145.7 17.08 shear failure/4 pt. J2-10 0° 350 178.0 19.43 3 pt./compression failure/4 pt. J2-12 0° 350 183.3 19.07 19.07		0.0	260		12.02	
Avg. 156.8 13.05 Std. Dev. 11.5 0.81 J2-3 0° 350 145.7 17.08 shear failure/4 pt. J2-10 0° 350 178.0 19.43 3 pt./compression for the state of the	J2-18	0°	260	158.2	12.57	↓
Std. Dev. 11.5 0.81 J2-3 0° 350 145.7 17.08 shear failure/4 pt. J2-10 0° 350 178.0 19.43 3 pt./compression to 19.07 J2-12 0° 350 183.3 19.07	J2-21	0°	260	176.2	13.97	tension failure/4 pt.
J2-3 0° 350 145.7 17.08 shear failure/4 pt. J2-10 0° 350 178.0 19.43 3 pt./compression t J2-12 0° 350 183.3 19.07	Avg.			156.8	13.05	
J2-10 0° 350 178.0 19.43 3 pt./compression for the property of the property	Std. Dev.			11.5	0.81	
J2-10 0° 350 178.0 19.43 3 pt./compression for the property of the property						
J2-12 0° 350 183.3 19.07	J2-3	0.	350	145.7	17.08	shear failure/4 pt.
	J2-10	0°	350	178.0	19.43	3 pt./compression fail
		0.0	350	183.3	19.07	
		0°	350	185.0	17.49	
J2-25 0° 350 197.4 17.31	···	0°	350	197.4	17.31	
Avg. 185.9 18.32 Avg. omits J2-3	Avg.			185.9	18.32	Avg. omits J2-3
Std. Dev. 8.2 1.08	Std. Dev.			8.2	1.08	

est: Fl aterials	exure : HyE 10'	76.3	L/D Ratio: 32:1			
pecimen Number	Fiber Orien- tation	Test Temp.	Ultimate Strength (ksi)	Modulus of Elasticity (10 ⁶ psi)	Remarks	
J1-5	90°	-67	8.34	1.66	4 pt. loading	
Jl-10	90°	~67	9.21	1.58		
J1-15	90°	-67	11.78	1.98		
J1-19	90°	-67	10.48	2.01		
J1-25	90.0	-67	11.73	1.98		
Avg.			10.31	1.84		
Std. Dev.			1.52	0.21		
J1~1	90°	72	8.58	1.64	4 pt. loading	
J1~6	900	72	7.38	1.57		
J1-12	900	72	8.47	1.60		
J1-18	90°	72	10.66	1.91		
J <u>1</u> ~24	90°	72	8.89	1.86		
Avg.			8.79	1.71		
Std. Dev.			1.19	0.16		
J1··4	90°	260	5.85	1.49	4 pt. loading	
J1-8	90°	260	6.54	1.58		
J1-16	90°	260	7.04	1.72		
J1-20	90°	260	8.62	1.71		
J1-26	90°	260	9.06	1.60		
A v g.			7.42	1.62		
Std. Dev.			1.37	0.10		
J1-2	90°	350	6.53	1.35	4 pt. loading	
J1-7	90 °	350	6.31	1.40		
J1-14	90°	350	7.79	1.66		
J1-21	90°	350	8.66	1.58		
J1-23	90°	350	5.86	1.25		
Avg.			7.03	1.45		
Std. Dev.			1.16	0.17	***************************************	

	exure			L/D Ratio:	32:1
Materials	G-160,	6535-1			
Specimen Number	Fiber Orien- tation	Test Temp. (°F)	Ultimate Strength (103 psi)	Modulus of Elasticity (10 ⁶ psi)	
K41-4	0°	-67	243.4	18.62	3 pt. loading/tens.fai
K41-9	0.	-67	236.3	17.70	
K41-21	0°	-67	251.6	19.09	
K41-23	0.0	-67	212.3	18.85	
K41-29	0°	-67	255.9	20.94	<u>, </u>
Avg.			239.9	19.04	•
Std. Dev.			17.2	1.19	
K41-1	0°	72	237.6	18.34	4 pt. loading/tens. &
K41-5	0°	72	230.7	18.22	compr. failure
K41-10	0°	72	235.9	18.33	
K41-20	0°	72	215.2	20.09	
K41-1 5	0°	72	237.0	17.48	
Avg.			231.3	18.49	
Std. Dev.			9.4	0.96	
K41-3	0°	260	199.5	19.06	4 pt. load/shear fail.
K41-7	0.0	260	128.0	19.40	4 pt. load/shear fail.
K41-11	0.0	260	214.2	18.49	3 pt. load/tens. &
K41-16	0°	260	223.5	17.33	compr. failure
K41-25	c.	260	221.5	18.19	
A v g.			219.7	18.00	omits K41-3 & K41-7
Std. Dev.			4.9	0.60	omits K41-3 & K41-7
K41-2	0°	350	186.5	16.21	3 pt. load/tens. &
к41-6	0°	350	179.6	16.44	compr. failure
K41-12	0 °	350	177.5	17.46	
K41-18	0.6	350	189.4	17.53	
K41-22	0°	350	175.8	16.62	
Λvg.			181.7	16.95	
Std. Dev.			5.9	0.61	

	exure	T 70 7	L/D Ratio:	32:1	
Materials Specimen Number	Fiber Orien- tation	Test Temp. (°F)	Ultimate Strength (103psi)	Modulus of Elasticity (10 ⁶ psi)	Remarks
K42-9	90°	-67	10.14	1.58	4 pt. load
K42-15	90°	~67	10.11	1.52	
K42-21	90 °	-67	7.09	1,50	
K42-3	90°	-67	8.59	1.83	
K42-23	90 °	-67	8.63	2.16	
Avg.			9.11	1.53	
Std. Dev.			1.75	0.04	
K42-1	90°	72	8.41	1.39	4 pt. load
K42-13	90°	72	9.29	1.46	
K42-25	90°	72	8.90	1.50	
K42-7	90 °	72	8.73	1.46	
K42-18	90°	72	8.64	1.41	
Avg.			8.86	1.45	
Std. Dev.			0.44	0.06	
K42-8	90°	260	6.65	1.48	4 pt. load
K42-20	90°	260	6.67	1.47	
K42-26	90°	260	5.86	1.41	
K42-4	90 °	260	7.78	1.42	
K42-14	90°	260	4.70	1.22	
Avg.			6.40	1.45	
Std. Dev.			0.47	0.04	
K42-2	90°	3 50	6.32	1.26	4 pt. load
K42-19	90°	350	6.75	1.49	
K42-24	90°	350	6.45	1.26	
K42-6	900	350	7.15	1.44	
K42-12	90°	350	7.56	1.33	
Avg.			6.50	1.34	
Std. Dev.			0.22	0.13	

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APPENDIX G INPLANE SHEAR DATA

All of the inplane shear data generated during this program are presented in this section. These data are both tabularly and graphically summarized in Sections 4.1 through 4.6.

Test: Inplane Shear Materials: T300/AFR800						
Specimen Number	Fiber Orien- tation	Test Temp.	Ultimate Strength (103psi)		Ultimate Strain (in/in)	Remarks
F23-5	±45	-67	13,900	0.71		
F24-1	±45	-67	13,360	0.67		
F25-7	±45	-67	12,850	0.65		
F26-4	‡ 45	-67	12,620	0.65		
F27-10	±45	-67	13,370	0.70		
Avg.			13,220	0.68		
Std.Dev.			500	0.03		
F23-9	±45	72	12,030	0.69		
F24-9	±45	72	11,900	0.72		· · · · · · · · · · · · · · · · · · ·
F25-5	±45	72	10,750	0.60		
F26-10	±45	72	11,850	0.66		
F27-1	±45	72	11,570	0.73		
Avg.			11,620	0.68		
Std.Dev.			520	0.05		
r23-11	±45	260	9,020	0.65		
F24-4	±45	260	7,720	0.59		
F25-1	Ì45	260	8,610	0.65		
F26-8	±45	260	8,730	0.60		
F27-3	±45	260	7,940	0.58		
Avg.			8,400	0.61		
Std.Dev.			550	0.03		
						
F23-3	±45	350	8,530	0.43		
F24-7	± 45	350	8,180	0.45		
F25-10	±45	350	8,560	0.45		
F26-2	±45	350	7,670	0.40		
F27-5	±45	350	7,720	0.41		
Avg.			8,130	ó.43		10
Std.Dev.			430	0.02		

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Materials	Materials: SiC/5506						
Specimen Number	Fiber Orien- tation	Test Temp. (°F)	Ultimate Strength (10 ³ psi)		Ultimate Strain (in/in)	Remarks	
G14-3	±45°	-67	10.31	1.02			
G14-4	±45°	-67	10.12	1.06			
G15-2	±45°	-67	10.20	1.07			
G17-3	±45°	-67	8.85	1.12			
G17-6	±45°	-67	9.83	1.07			
Avg.			9.86	1.07			
Std.Dev.			0.59				
G14-5	±45°	72	8.85	0.76			
G15-1	±45°	72	8.26	0.87			
G15-4	± 45°	72	8.76	0.76			
G17-1	± 45°	72	3.97	0.88			
G17-4	± 45°	72	8.46	0.73			
Avg.			8.66	0.80			
Std.Dev.			0.29	0.07			
G14-7	± 45°	260	5.80	0.50			
G16-4	± 45°	260	6.27	0.33			
G17-2	± 45°	260	6.11	0.39			
G17-7	± 45°	260	5.37	0.37			
G17-8	± 45°	260	5.35	0.39			
Avg.		1	5.78	0.39			
Std. Dev.		 	0.42	0.06			
300.	+	 					
G14-1	± 45°	350	3.97	0.12			
G14-2	± 45°	350	3.93	0.11			
G14-6	± 45°	350	3.94	0.18			
G15-3	± 45°	350	4.09	0.11			
G17-5	± 45°	350	3.84	0.10			
	1	+	3.95	0.12	 		
Avg.	 	+	0.09	0.03	+		
Bea. Dev.	1		1		<u></u>	<u></u>	

Test: In								
Materials	Materials: HyE 2034D							
Specimen Number	Fiber Orien- tation	Test Temp. (°F)	Ultimate Strength (10 ³ psi)	Inplane Shear Modulus (10 ⁶ psi)	Ultimate Strain (in/in)	Remarks		
H11-8	±45°	-67	5.83	0.99				
H16-4	±45°	-67	6.12	1.02				
H17-4	±45°	-67	5.81	1.02				
H17-7	±45°	-67	6.22	1.00				
H12-7	±45°	-67	5.67	1.31				
Avg.			5.93	1.07				
Std.Dev.			0.23	0.14				
H11-7	±45°	72	5.51	0.76				
H13-8	±45°	72	5.50	0.80				
H15-4	±45°	72	5.39	0.68				
H15-5	±45°	72	5.59	0.74				
H15-7	±45°	72	5.14	0.66				
Avg.			5.43	0.73				
Std.Dev.			0.17	0.06				
H10-2	±45°	260	4.68	0.68				
H12~13	±45°	260	4.70	0.68				
H13-1	±45°	260	4.88	0.66				
H14-10	± 45°	260	4.48	0.63				
H17-6	±45°	260	4.47	0.66				
Avg.			4.69	0.66				
Std.Dev.			0.14	0.02				
						·		
H10-5	± 45°	350	4.36	0.68				
н11-9	± 45°	350	4.21	0.60				
H14-5	± 45°	350	4.54	0.56				
H18-2	± 45°	350	4.56	0.62				
н19-4	± 45°	350	4.22	0.57				
Avg.			4.38	0.61				
Std.Dev.			0.17	0.04				

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<u> materials</u>	Materials: T300/V378A							
Specimen Number	Fiber Orien- tation	Test Temp. (°F)	Ultimate Strength (10 ³ psi)		Ultimate Strain (in/in)	Remarks		
14-6	±45	-67	11.19	0.91				
15-10	±45	-67	11.56	0.97				
16-8	±45	-67	10.48	0.92				
19-1	±45	-67	10.42	0.90				
110-5	±45	-67	10.17	0.92				
Avg.			10.76	0.92				
Std.Dev.			0.59	0.03				
I4-3	±45	72	9.59	0.89				
19-9	±45	72	11.07	0.95				
110-7	±45	72	10.71	0.97				
111-5	±45	72	10.98	0.91				
122-1	±45	72	10.88	0.95				
Avg.			10.65	0.93				
Std.Dev.			0.61	0.03				
18-6	+45	350	8.13	0.85				
19-8	±45	350	8.09	0.88				
110-10	±45	350	7.48	0.76				
111-4	±45	350	8.39	0.95				
122-2	±45	350	8.21	<u></u>				
Avg.		ì	8.06	0.86				
Std.Dev.			0.35	0.08				
15-1	±45	450	7.23	0.63				
18-7	±45	450	7.46	0.69				
19-6	±45	450	7.51	0.58				
110-9	±45	450	7.44	0.54				
111-8	±45	450	7.70	0.58				
Avg.			7.47	0.60				
Std.Dev.			0.17	0.06				

	olane Sh	ear						
Materials	Materials: HyE 1076J							
Specimen Number	Fiber Orien- tation	Test Temp. (°F)	Ultimate Strength (10 ³ psi)	Inplane Shear Modulus (10 ⁶ psi)	Ultimate Strain (in/in)	Remarks		
J4-3	±45°	-67	13.39	0.99				
J6-2	±45°	-67	15.46	0.89				
J8-2	±45°	-67	13.20	1.08				
J10-2	±45°	-67	13.34	1.03				
J11-3	±45°	-67	13.34	1.03				
Avg.			13.75	1.00				
Std.Dev.			0.96	0.07				
J3-2	±45°	72	11.00	0.90				
J5-6	±45°	72	11.09	0.84				
J8-2	±45°	72	11.08	0.94				
J11-2	±45°	72	11.36	0.93				
J12-2	±45°	72	11.17	0.96				
Avg.			11.14	0.92				
Std.Dev.			0.14	0.05				
J3-1	±45°	260	7.78	0.87				
J5-1	±45°	260	7.90	0.90				
J71	±45°	260	8.72	0.92				
J9-1	±45°	260	8.45	0.94				
J11-1	±45°	260	8.38	0.82				
Avg.			8.25	0.89				
Std.Dev.			0.40	0.05				
J3-6	±45°	350	8.36	0.79				
J4-2	±45°	350	8.18	0.81				
J7-6	±45°	350	9.36	0.70				
J97	±45°	350	7.67	0.82				
J11-8	±45°	350	7.93	0.71				
Avg.			8.30	0.77				
Std.Dev.	<u> </u>		0.65	0.06				

Materials	Materials: G-160/6535-1							
Specimen Number	Fiber Orien- tation	Test Temp. (°F)	Ultimate Strength (10 ³ psi)	Modulus	Ultimate Strain (in/in)	Remarks		
K4-4	±45°	-67	9.34	1.03				
K6-2	±45°	-67	9.85	0.97				
K7-4	±45°	-67	10.44	0.96				
K10-3	±45°	-67	9.44	1.01				
K11-1	±45°	-67	9.47	1.10				
Avg.			9.71	1.01				
Std.Dev.			0.45	0.06	ì			
K5-1	±45°	72	8.87	0.94				
K6-1	±45°	72	9.00	0.96				
K7-1	±45°	72	7.68	0.98				
K8-1	±45°	72	8.90	0.90				
K9-1	±45°	72	7.72	0.94				
Avg.			8.43	0.94				
Std.Dev.			0.67	0.03				
K4-2	±45°	260	7.74	0.82				
K5-2	±45°	260	7.90	0.96				
K7-2	±45°	260	7.94	0.89				
K9-2	±45°	260	7.86	0.87				
K10-2	±45°	260	7.42	0.89				
Avg.			7.77	0.89				
Std.Dev.			0.21	0.05				
K4-3	±45°	350	7.76	0.79				
K5-3	±45°	350	8.74	0.84				
K7-3	± 45°	350	8.66	0.86				
K9-3	± 45°	350	8.50	0.80				
K10-2	± 45°	350	7.54	0.78				
Avg.			8.24	0.81				
Std.Dev.			0.55	0.03				

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APPENDIX H INTERLAMINAR SHEAR DATA

All of the interlaminar shear data generated during this program are tabulated in this appendix. Tabular summaries of these data appear in Sections 4.1 through 4.6.

Test: Inte Materials:	rlaminar (more-beam)	Shear L/D Ratio: 4/l
Specimen Number	Test Temp. (°F)	Ultimate Strength (psi)	Remarks
F21-23	67	19,020	
F21-45	-67	17,550	
F21-55	-67	17,700	
F21-58	-67	17,270	
F21-61	-67	19,290	
Avg.		18,170	
Std.Dev.		920	
F21-6	72	15,290	
F21-9	72	15,520	
F21-11	72	17,160	
F21-20	72	14,440	
F21-36	72	15,310	
F21-53	72	15,340	
F21-64	72	14,370	
F21-66	72	14,620	
F21-69	72	15,400	
F21-75	72	15,160	
Avg.		15,270	
Std.Dev.		790	
F21-33	260	12,810	
F21-43	260	11,020	
F21-44	260	11,920	
F21-57	260	11,300	
F21-68	260	11,820	
Avg.		11,770	
Std. Dev.		690	

	laminar (Short-Beam)	Shear
Materials:	T300/AFR800		L/D Ratio: 4/1
Specimen Number	Test Temp. (°F)	Ultimate Strength (psi)	Remarks
F21-7	350	9,880	
F21-12	350	9,270	
F21-26	350	10,000	
F21-51	350	9,320	
F21-56	350	9,680	
Avg.		9,630	
Std.Dev.		330	
		-	
<u> </u>		L	

Test Test Strength Test Tes	Test: Inter		Short-Beam)	Shear
Specimen Number Temp. (°F) Strength (10³ psi) Remarks G38-6 -67 21.27 38-28 -67 21.63 38-51 -67 21.63 38-51 -67 21.06 38-51 -67 21.06 38-63 -67 21.10 38-63 -67 21.10 38-63 -67 21.10 38-2 72 14.80 38-2 72 14.80 38-2 72 14.85 38-8 72 14.96 38-12 72 15.01 38-20 72 15.21 38-20 72 15.21 38-20 72 15.21 38-24 72 14.72 38-30 72 14.96 38-30 72 14.96 38-30 72 15.19 38-48 72 15.19 38-48 72 15.19 38-48 72 15.31 38-49 72 15.02 38-40 72 15.02 38-10 38-16 38-16 38-16 38-16 38-16 38-16 38-16 38-16 38-16 <t< th=""><th>Materials:</th><th>Sic/5506</th><th></th><th>L/D Ratio: 4/l</th></t<>	Materials:	Sic/5506		L/D Ratio: 4/l
G38-28		Temp.		Remarks
G38-51	G38-6	-67	21.27	
G38-57 -67 21.06 G38-63 -67 21.10 Avg. 21.29 Std.Dev. 0.25 G38-2 72 14.80 G38-4 72 14.85 G38-8 72 14.96 G38-12 72 15.01 G38-20 72 15.21 G38-24 72 14.72 G38-30 72 14.96 G38-30 72 15.20 G38-40 72 15.19 G38-40 72 15.19 G38-40 72 15.19 G38-40 72 15.31 Avg. 15.02 Std.Dev. 0.20 G38-1 260 8.81 G38-39 260 8.86 G38-41 260 9.20 G38-54 260 9.18 Avg. 9.12	G38-28	-67	21.68	
G38-63 -67 21.10 Avg. 21.29 Std.Dev. 0.25 G38-2 72 14.80 G38-4 72 14.85 G38-8 72 14.96 G38-12 72 15.01 G38-20 72 15.21 G38-24 72 14.72 G38-30 72 14.96 G38-36 72 15.20 G38-40 72 15.19 G38-48 72 15.31 Avg. 15.02 Std.Dev. 0.20 G38-1 260 8.81 G38-39 260 8.86 G38-41 260 9.18 Avg. 9.12	G38-51	-67	21.32	
Avg. 21.29 Std.Dev. 0.25 G38-2 72 14.80 G38-4 72 14.85 G38-8 72 14.96 G38-12 72 15.01 G38-20 72 15.21 G38-24 72 14.72 G38-30 72 14.96 G38-36 72 15.20 G38-40 72 15.19 G38-48 72 15.31 Avg. 15.02 Std.Dev. 0.20 G38-1 260 8.81 G38-39 260 8.86 G38-41 260 9.20 G38-54 260 9.18 Avg. 9.12	G38-57	-67	21.06	
G38-2 72 14.80 G38-4 72 14.85 G38-8 72 14.96 G38-12 72 15.01 G38-20 72 15.21 G38-24 72 14.72 G38-30 72 14.96 G38-36 72 15.20 G38-40 72 15.19 G38-48 72 15.31 Avg. 15.02 Std.Dev. 0.20 G38-1 260 8.81 G38-39 260 8.86 G38-41 260 9.20 G38-54 260 9.18 Avg. 9.12	G38-63	-67	21.10	
G38-2 72 14.80 G38-4 72 14.85 G38-8 72 14.96 G38-12 72 15.01 G38-20 72 15.21 G38-24 72 14.72 G38-30 72 14.96 G38-36 72 15.20 G38-40 72 15.19 G38-48 72 15.31 Avg. 15.02 Std.Dev. 0.20 G38-1 260 8.81 G38-39 260 8.86 G38-41 260 9.20 G38-54 260 9.18 Avg. 9.12	Avg.		21.29	
G38-4 72 14.85 G38-8 72 14.96 G38-12 72 15.01 G38-20 72 15.21 G38-24 72 14.72 G38-30 72 14.96 G38-36 72 15.20 G38-40 72 15.19 G38-48 72 15.31 Avg. 15.02 Std.Dev. 0.20 G38-1 260 8.81 G38-16 260 9.55 G38-39 260 8.86 G38-41 260 9.20 G38-54 260 9.18 Avg. 9.12	Std.Dev.		0.25	
G38-4 72 14.85 G38-8 72 14.96 G38-12 72 15.01 G38-20 72 15.21 G38-24 72 14.72 G38-30 72 14.96 G38-36 72 15.20 G38-40 72 15.19 G38-48 72 15.31 Avg. 15.02 Std.Dev. 0.20 G38-1 260 8.81 G38-16 260 9.55 G38-39 260 8.86 G38-41 260 9.20 G38-54 260 9.18 Avg. 9.12				
G38-8 72 14.96 G38-12 72 15.01 G38-20 72 15.21 G38-24 72 14.72 G38-30 72 14.96 G38-36 72 15.20 G38-40 72 15.19 G38-48 72 15.31 Avg. 15.02 Std.Dev. 0.20 G38-1 260 8.81 G38-39 260 8.86 G38-41 260 9.20 G38-54 260 9.18 Avg. 9.12	G38-2	72	14.80	
G38-12 72 15.01 G38-20 72 15.21 G38-24 72 14.72 G38-30 72 14.96 G38-36 72 15.20 G38-40 72 15.19 G38-48 72 15.31 Avg. 15.02 Std.Dev. 0.20 G38-1 260 8.81 G38-16 260 9.55 G38-39 260 8.86 G38-41 260 9.20 G38-54 260 9.18 Avg. 9.12	G38-4	72	14.85	
G38-20 72 15.21 G38-24 72 14.72 G38-30 72 14.96 G38-36 72 15.20 G38-40 72 15.19 G38-48 72 15.31 Avg. 15.02 Std.Dev. 0.20 G38-1 260 8.81 G38-39 260 8.86 G38-41 260 9.20 G38-54 260 9.18 Avg. 9.12	G38 - 8	72	14.96	
G38-24 72 14.72 G38-30 72 14.96 G38-36 72 15.20 G38-40 72 15.19 G38-48 72 15.31 Avg. 15.02 Std.Dev. 0.20 G38-1 260 8.81 G38-39 260 8.86 G38-41 260 9.20 G38-54 260 9.18 Avg. 9.12	G38-12	72	15.01	
G38-30 72 14.96 G38-36 72 15.20 G38-40 72 15.19 G38-48 72 15.31 Avg. 15.02 Std.Dev. 0.20 G38-1 260 8.81 G38-16 260 9.55 G38-39 260 8.86 G38-41 260 9.20 G38-54 260 9.18 Avg. 9.12	G38~20	72	15.21	
G38-36 72 15.20 G38-40 72 15.19 G38-48 72 15.31 Avg. 15.02 Std.Dev. 0.20 G38-1 260 8.81 G38-16 260 9.55 G38-39 260 8.86 G38-41 260 9.20 G38-54 260 9.18 Avg. 9.12	G38-24	72	14.72	· ·
G38-40 72 15.19 G38-48 72 15.31 Avg. 15.02 Std.Dev. 0.20 G38-1 260 8.81 G38-16 260 9.55 G38-39 260 8.86 G38-41 260 9.20 G38-54 260 9.18 Avg. 9.12	G38-30	72	14.96	
G38-48 72 15.31 Avg. 15.02 Std.Dev. 0.20 G38-1 260 8.81 G38-16 260 9.55 G38-39 260 8.86 G38-41 260 9.20 G38-54 260 9.18 Avg. 9.12	G38-36	72	15.20	
Avg. 15.02 Std.Dev. 0.20 G38-1 260 8.81 G38-16 260 9.55 G38-39 260 8.86 G38-41 260 9.20 G38-54 260 9.18 Avg. 9.12	G38-40	72	15.19	
Std.Dev. 0.20 G38-1 260 8.81 G38-16 260 9.55 G38-39 260 8.86 G38-41 260 9.20 G38-54 260 9.18 Avg. 9.12	G38-48	72	15.31	
G38-1 260 8.81 G38-16 260 9.55 G38-39 260 8.86 G38-41 260 9.20 G38-54 260 9.18 Avg. 9.12	Avg.		15.02	
G38-16 260 9.55 G38-39 260 8.86 G38-41 260 9.20 G38-54 260 9.18 Avg. 9.12	Std.Dev.		0.20	
G38-16 260 9.55 G38-39 260 8.86 G38-41 260 9.20 G38-54 260 9.18 Avg. 9.12				
G38-39 260 8.86 G38-41 260 9.20 G38-54 260 9.18 Avg. 9.12	G38-1	260	8.81	
G38-41 260 9.20 G38-54 260 9.18 Avg. 9.12	G38-16	260	9.55	
G38-54 260 9.18 Avg. 9.12	G38-39	260	8.86	
Avg. 9.12	G38-41	260	9.20	
	G38-54	260	9.18	
Std.Dev. 0.30	Avg.		9.12	
	Std.Dev.		0.30	

Test: Inter	laminar (Short-Beam)	Shear
Materials:	SiC/5506		L/D Ratio: 4/1
Specimen Number	Test Temp. (°F)	Ultimate Strength (10 ³ psi)	Remarks
G38-17	350	7.53	
G38-25	350	8.01	
G38-33	350	8.59	
G38-44	350	8.11	
G38-60	3 50	7.83	
Avg.		8.01	
Std.Dev.		0.39	
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		Short-Beam)	Shear
Materials:	HyE 2034D		L/D Ratio: 4/1
Specimen Number	Test Temp. (°F)	Ultimate Strength (103 psi)	Remarks
H31-2	-67	9.06	
н31-7	-67	7.83	
н31-16	-67	8.14	
н31-44	-67	7.91	
н31-54	-67	7.51	
Avg.		8.09	·
Std.Dev.		0,59	
нз1-1	72	7.57	
нз1-5	72	7.17	
H31··10	72	7.07	
H31-22	72	7.85	
H31-36	72	7.06	
н31-42	72	7.57	
н31-48	72	7.57	
н31-51	72	6.55	
H3 1- 55	72	6.97	
н31-66	72	6.45	
Avg.		7.18	
Std.Dev.		0.46	
H31-3	260	7.12	
н31-8	260	6.24	
н31-28	260	6.13	
H31-30	260	6.04	
H31-46	260	6.87	
Avg.		6.48	
Std.Dev.		0.48	
		<u> </u>	

Test: Inter	laminar (Short-Beam)	Shear
Materials:	HyE 2034D		L/D Ratio: 4/1
Specimen Number	Test Temp. (°F)	Ultimate Strength (10 ³ psi)	Remarks
н31-17	350	6.17	
H31-24	350	5.82	
H31-40	350	5.95	
H31-53	350	5.74	
н31-64	350	5.48	
Avg.		5 .83	
Std.Dev.		0.26	
ļ			
		<u> </u>	

	rlaminar (Short-Beam)	Shear
Materials:	T300/V378A		L/D Ratio: 4/l
Specimen Number	Test Temp. (°F)	Ultimate Strength (psi)	Remarks
I15-9	-67	18,800	
I15-14	-67	17,300	
115-26	-67	18,540	
I15-38	-67	18,250	
115-39	-67	17,720	
Avg.		18,140	
Std.Dev.		630	
115-1	72	15,400	
115-4	72	15,560	
115-8	72	14,860	
115-13	72	14,230	
I15-20	72	14,520	
115-25	72	15,550	
I15-29	72	15,160	
115-32	72	15,170	
115-37	72	14,410	
I15-45	72	15,320	
Avg.		15,020	
Std.Dev.		490	
I15 - 10	350	9,030	
115-16	350	10,090	
115-24	350	10,190	
115-27	350	10,760	
I15-34	350	10,010	
Avg.		10,020	
Std.Dev.		620	
1		1	

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Test: Inte	rlaminar (Short-Beam)	Shear	
Materials:	T300/V378A		L/D Ratio: 4/1	
Specimen Number	Test Temp. (°F)	Ultimate Strength (psi)	Remarks	
115-2	450	8,960		
115-6	450	9,230		
115-17	450	9,430		
115-28	450	9,270		
115-43	450	9,310		
Avg.		9,240		
Std.Dev.		170		
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		Short-Beam	Shear
Materials:	нуЕ 1076Ј	t	L/D Ratio: 4/1
Specimen Number	Test Temp. (°F)	Ultimate Strength (103 psi)	Remarks
J26-23	-67	16.26	
J26-4 <u>1</u>	-67	14.24	
J26-67	-67	19.64	
J26-78	-67	15.25	
J26-80	-67	17.72	
Avg.		16.62	
Stā.Dev.		2.12	
J26-16	72	11.04	
J26-19	72	9.42	
J26-26	72	10.96	
J26-33	72	14.94	
J26-40	72	11.67	
J26-49	72	12.66	
J26-53	72	11.67	
J26- 69	72	17.11	
J26-74	72	14.70	
J26-83	72	14.56	
Avg.		12.87	
Std.Dev.		2.36	
J26-18	260	8.59	
J26-34	260	10.79	
J26-38	260	8.96	
J26~52	260	8.61	
J26-64	260	9.85	
Avg.		9.36	
Std.Dev.		0.95	

aterials:	НуЕ 1076Ј	Short-Beam)	L/D Ratio: 4/1
Specimen Number	Test Temp.	Ultimate Strength (103 psi)	Remarks
J26~14	350	7.71	
J26-22	350	8.89	
J26-46	350	8.58	
J26-57	350	9.56	
J26-61	350	8.25	
Avg.		8.60	
Std.Dev.		0.69	
	 		
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	rlaminar (Short-Beam)	Shear
Materials:	G-180/6535	-1	L/D Ratio: 4/l
Specimen Number	Test Temp. (°F)	Ultimate Strength (103psi)	Remarks
K18-12	-67	17.51	
K18-28	-67	18.21	
K18-38	-67	15.19	
K18-46	-67	16.65	
K18-62	-67	17.20	
Avg.		16.96	
Std. Dev.		1.14	
K18-1	72	14.03	
K18-10	72	15.55	
K18-18	72	15.87	
K18-23	72	14.21	
K18-31	72	13.10	
K18-34	72	14.26	
K18-37	72	12.84	
K18-41	72	13.79	
K18-47	72	16.13	
K18-52	72	15.54	
Avg.		14.53	
Std. Dev.		1.17	
			\
K18-2	260	11.36	
K18-16	260	11.46	
K18-48	260	12.39	
K18-57	260	12.28	
K18-63	260	12.02	
Avg.		11.90	
Std. Dev.		0.47	

Test: Inter	laminar (Short-Beam)	Shear
Materials: G	-160/6535-	1	L/D Ratio: 4/1
Specimen Number	Test Temp. (°F)	Ultimate Strength (10 ³ psi)	Remarks
K18-9	350	8.76	
K18-26	350	9.53	
K18-35	350	8.46	
K18-44	350	9.79	
K18-55	350	9.78	
Avg.		9.27	
Std. Dev.		0.62	
			

APPENDIX I FATIGUE DATA

All of the tensile-tensile fatigue data generated during the program, along with residual strengths of specimens which "ran out" to 107 cycles are presented here. The residual strengths were all determined with a tensile test at 72°F (22°C), regardless of what temperature the specimen saw during the fatigue test. Summaries of these data are presented in Sections 4.1 through 4.6 in both tabular and graphical form.

Professionary Professionar				444						R * +0.1
Piber Tank Hax. Hin. Hax. Cycles Tange in the straight of the str	Test	683		C C						
Operation of the control of	Macer		7 10 7							Function: Sine
0 72 143.7 12.4 80 327,700	Specimen	Piber Orienta-	Test.	Max. Stress	Min. Stress	Max. Stress	Cycles to Failure	Temp. Rise (*F)	Residual Strength (10 ³ psi)	Remarks
0° 72 143.7 14.4 80 23,600 0° 72 143.7 14.4 80 \$1,200 0° 72 143.7 14.4 80 345.500 0° 72 144.7 12.5 75 0,000,000+ 229.9 0° 72 134.7 13.5 75 10,000,000+ 229.9 2 0° 72 134.7 13.5 75 10,000,000+ 229.9 3 0° 72 134.7 13.5 75 10,000,000+ 229.9 10 0° 72 134.7 13.5 75 10,000,000+ 229.9 11 0° 72 134.7 13.5 75 10,000,000+ 229.9 2 0° 72 134.7 13.5 75 10,000,000+ 229.3 <th>Number</th> <th>1000</th> <th>72</th> <th>143.7</th> <th>14.4</th> <th>80</th> <th>327,700</th> <th>1 1</th> <th></th> <th></th>	Number	1000	72	143.7	14.4	80	327,700	1 1		
25-10 20 72 143.7 14.4 80 1,400	F1-4	00	72	, m		80	23,600	7 7 8	***	
73-5 73-5 73-5 73-5 73-6 72-6 72-7 73-7		0,	7.2	4.3	1 4	80	51,200	1		
14.6 0° 72 14.7 14.4 80 345.500 229.9 14.7 12.5 75 0.000,000+ 229.9 14.7 13.5 75 166,200 229.9 14.7 13.5 75 166,200 151.3 15.2 14.7 13.5 75 16,000,000+ 239.7 13.5 13.7 13.5 75 10,000,000+ 223.3 15.2 13.7 13.5 75 10,000,000+ 223.3 15.2 12.5 12.5 12.6 70 10,000,000+ 223.3 15.5 12.6 70 10,000,000+ 203.7 12.5 12.5 12.6 70 10,000,000+ 209.3 12.5 12.5 12.6 70 10,000,000+ 209.3 12.5 12.5 12.6 70 10,000,000+ 209.3 12.5 12.5 12.6 70 10,000,000+ 209.3 12.5 12.5 12.6 70 1,999,400 +5 209.3 12.5 12.5 12.6 70 1,999,400 209.3 12.5 12.5 12.6 70 1,999,400 209.3 12.5 12.5 12.6 70 1,999,400 209.3 12.5	11 1	00	72	• •		30	1,400	\$ \$	1	en e
756 0° 72 134.7 12.5 75 10.000,000+ 229.9		00	7.2		N 21	8.0	345.500		1	
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$\begin{array}{cccccccccccccccccccccccccccccccccccc$	0-24	00		2.4	4 .	75				The second s
122-15 0° 72 134.7 13.5 75 10,000,000+ 239.7		000	7.5		į,	75	294	1	- 1	
F22-5 0° 72 134.7 13.5 75 10,000,000+ 223.3 F22-11 0° 72 134.7 13.5 75 10,000,000+ 223.3 F22-12 0° 72 125.7 12.6 70 10,000,000+ 201.7 F4-4 0° 72 125.7 12.6 70 10,000,000+ 198.8 F5-1 0° 72 125.7 12.6 70 10,000,000+ 209.3 F6-7 0° 72 125.7 12.6 70 10,999,400 +5 failed by operator	-(i	0	7.2	4 .	, m			i (s	•	
F3-11 0° 72 134.7 13.5 75 10,000,000+ 223.3 F3-12 0° 72 125.7 12.6 70 7',800 201.7 F4-4 0° 72 125.7 12.6 70 10,000,000+ 198.8 F5-1 0° 72 125.7 12.6 70 10,000,000+ 209.3 F6-7 0° 72 125.7 12.6 70 10,000,000+ 209.3 F6-7 0° 72 125.7 12.6 70 5.888.600 failed by operator		0,0		.] .				i	9	and the second s
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F4-4 0° 72 125.7 12.6 70 10,000,000+ 201.7 F4-5 0° 72 125.7 12.6 70 10,000,000+ 198.8 F5-1 0° 72 125.7 12.6 70 10,000,000+ 209.3 F6-7 0° 72 125.7 12.6 70 1,999,400 +5 failed by operator F22-10 0° 72 125.7 12.6 70 5.888.600 failed by operator	-	00		5	1	7.0	7,800	į.	1	en e
F5-1 0° 72 125.7 12.6 70 10,000,000+ 198.8 F5-1 0° 72 125.7 12.6 70 10,000,000+ 209.3 F5-1 0° 72 125.7 12.6 70 1,999,400 +5 failed by operator F22-16 0° 72 125.7 12.6 70 5.888.600 failed by operator	4 - 0	0		125.7	~	7.0	١.		•]	
F5-1 0° 72 125.7 12.6 70 10,000,000+ 209.3 F6-7 0° 72 125.7 12.6 70 1,999,400 +5 failed by operator F22-16 0° 72 125.7 12.6 70 5.888.600 failed by operator	1 1	00		ي	2	7.0	000	1	198.8	
F6-7 0° 72 125 7 12.6 70 1,999,400 +5 failed by operator	5.6.2	00	7.2	5	7	7.0	000	1	209.3	
F22-16 0° 72 125.7 12.6 70 5.888.600 failed by operator	F6-7	00	72	5	2	7.0	666′		+	
	F22-1	0		1	2	7.0		1	11	þX
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			Residual Strength	i			\$ 1	1	1	l E	\$ 44 B	 	774 440 MIO	1	ł	* *	i i	187.6							
			Temp. Rise (*F)		+8		r+	+16	+5	+7	+9	e+	9+		9+	+3	۳ +	+1							Y
			Cycles to Failure	700	197,200	1,000	1,500	-	1,16,500	12,800	6,900	806,600	5,622,100	7,185,700	•	3,531,600	4,806,800	10,000,000+			of the character of a fight from the principal and the contribution of the special con	- And the start the starting of the starting o	utain-i-finatriumping-i-i-i-i-i-i-i-i-i-i-i-i-i-i-i-i-i-i-		The state of the s
			Max. Stress (1 ult.)	06	06	06	90	06	80	80	80	80	80	7.5	7.5	7.5	7.5	7.5							A
			Min. Stress (10 psi)	17.5	17.5	17.5	17.5	17.5	15.5	15.5	15.5	•	15.5	14.5	•	14.5	14.5	14.5							
atigne	C		Max. Stress	174.5		174.5	174.5	-	155.1	155.)	155.1	•		145.4	-	145.4									
ensile F	T300/AFRE00		Tost Temp. (*F)	260	260	260	260	260	260	260	260	260	260	260	260	260	260	260							
Tensile-Tensile Fatique			Piber Orienta-	00	00	0	00	00	0	0	00	0 0	00	° 0	00	00	00	00							
Test:	Material:		Specimen	F4-13		F6-16	F22-7	F22-10	F4-10	F5-8	F6-1	F22-2	F22-13	F5-14	F6-14	F22-4	F22-6	F22-14							

R = +0.1	Frequency # 30 Hz	Function: Sine	Remarks	didn't reach full load	before failure				The second secon																		
			Residual Strength (10 ³ ps1)	! !	t 1				1	1		_	1				-		6.4	1			4.6				
			Temp. Risc (*F)			* * *				1 5	1 1	1	ł	1 1	1	10 10	1		£ 1	1 1	1	1	1				
			Cycles to Failure	700	200	200	30,200	602,300	1,111,300	43,700	56,200	400	22,600	19,700	2,100	151,100	-		10,000,000-	2,994,700	22,700	314.900	10,000,000				
			Max. Stress	80	80	80	7.0	7.0	7.0	7.0	70	70	65	65	65	6.5	65		60	60	60	9	60				
			Min. Stress	0.37	0.37	0,37	0.32	0.32	0.32	7.32	6	٣.	0.30			0 30	4 •	Ì	0.28	2		0.28		4			
610014	200		Max. Stress	3.66	3.66	3.66	3.21	2	7	3.21		(1	2 98	• •	• •	200	ન •	1	2.75	1.	2.75	2.75					
o Class		T300/AFREDU	Test Temp.	T	72	72	72	7.2	72	7.2	7.2	72	7.2	7.2	72	7.2	72		72	72	72	72	7.2				
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	Test:	Material:	Specimen	Number	17-1	F11-4	F13-3	7 7 -	-91	17-	717	1-	l u	212-3	7	0	11.	1	F9-2			F13-8	013-10	21		-	

adipolitical designation of the second of th	en s	ens	ile F	atique						R = +0.1 Frequency = 30 Hz
Max. Gycles Temp. Strength (* 11t.) Residual strength (* 12t.) (* 11t.) Failure (**) * 1.0	g	i	i							1 .1
70 400 65 18,800 0 65 3,300 +1 65 10,700 0 60 25,400 0 60 400 +1 60 400 +1 60 10,000,000 3 55 10,000,000 1 6.1 50 10,000,000 1 6.1 50 10,000,000 1 6.1 60 10,000,000 1 6.1 60 10,000,000 1 6.1	Piber Test Max. Orienta- Temp. Stress tion (*F) (10 ³ psi)		Max. Stress (10 ³ psi)		Min. Stress (10-bst)	Max. Stress (% ult.)	Cycles to Failure	Temp. Rise (*F)	Residual Strength (10 ³ ps1)	Remarks
.30 65 18,800 030 65 3,300 +130 65 10,700 028 60 25,400 028 60 400 +128 60 77,207,000 328 60 10,000,000+ 11 726 55 10,000,000+ 1 6.1 .23 50 10,000,000+ 1 6.4	90 ⁰ 260 3.28		3.28		0.33	7.0	400	1	1	te der verbreige des en
.30 65 18,800 0 .30 65 3,300 +1 .30 65 10,700 0 .28 60 500 +2 .28 60 400 +1 .28 60 10,000,000 +1 .26 55 10,000,000 +1 .23 50 10,000,000 1 6.1 .23 50 10,000,000 1 6.2										
.30 65 3,300 +1 .30 65 10,700 0 .28 60 25,400 0 .28 60 400 +1 .28 60 17,207,000 3 .28 60 10,000,000+ +1 .26 55 10,000,000+ 1 6.1 .23 50 10,000,000+ 1 6.4 .23 50 10,000,000+ 1 6.4	90° 260 2.98	2.	•		• i	65	8	0	- 1 [
.30 65 10,700 028 60 55,400 028 60 400 +128 60 7,207,000 328 60 10,000,000+ 11 726 55 10,000,000+ 11 6.1 .27 50 10,000,000+ 1 6.1	90 ⁰ 260 2.98	2.	•1		•	65	4	+1	1	
.28 60 500 +228 60 400 +128 60 7,207,000 328 60 10,000,000+ +1 726 55 10,000,000+ 1 6.1 .23 50 10,000,000+ 1 6.4	260	2.	•		•	65	o	0	- 1	
28 60 55,400 0 28 60 400 +1 28 60 7,207,000 3 28 60 10,000,000+ +1 7. 28 50 10,000,000+ 1 6.1 23 50 10,000,000+ 1 6.4		•								
25,400 0 28 60 400 +1 28 60 10,000,000+ 11 7. 26 55 10,000,000+ 1 6. 23 50 10,000,000+ 1 6.	90 ⁰ 260 2.81	2.8	8	1	•	09	500	+2	1	
.28 60 400 +128 60 10,000,000+ +1 726 55 10,000,000+ 1 6.1 .23 50 10,000,000+ 1 6.4 .23 50 10,000,000+ 1 6.4	90 ⁹ 260 2.81	2.	•		•	09	5,	0	1	
.28 60 17,207,000 328 60 10,000,000+ +11 726 55 10,000,000+ 1 6.1 .23 50 10,000,000+ 1 6.4	90 ⁰ 260 2.81	2.	•		٠	09	400	+1	- ()	
.28 60 10,000,000+ +1 726 55 10,000,000+ 1 6.1 .23 50 10,000,000+ 1 6.4	260 2.81	2.81	.81		•	0.9	7,207,000	Э	•	e de la la companya de la companya del la companya de la compa
.26 55 10,000,000+ '1 6. .23 50 10,000,000+ 1 6.	260 2.81	2.81	.81		•	09	+000,000,01	+	•	
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23 50 10,000,000+ 1 6.	90 260 2.57 0	2.57	.57	9	.26	5.5	10,000,000+	7	-1	
	90° 260 2.34 0	2.34 0	.34 0	0	~	50	ó	-		
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+ # # # # #	Frequency Function:																					-					
		Residual Strength (10 ³ psi)	; I i						1 1	-	1		4		(1	1	1								
		Temp. Rise (*F)	! } E	1	1		1		9+	+6	+7	+7	+5		+11	+17	+7	+7	+7								-
		Cycles to Pailure	13,300	19,700	29,000	21,700	10,500		36,800	48,500	12,900	68,700	154,500		1,199,300	146,100	3,985,200	1,654,000									
		Max. Stress	7.0	7.0	70	7.0	7.0		65	65	65	65	65		09	09	09	09	60								
		Min. Stress	1.63	1 -	9	1.63	1.63	1	1.51	1.51	i '	•	1.51		1.39	١.	1.39	J.	١ •								
atigue	a	Max. Stress	16.27		16.27	16.27		ı	15.11	15.11	1.5.	• •	15.11	,	13.94	(m)	13.94	٠.	١.					-			
ensile F	T300/AFRBOO	fest Temp.	7.2	7.2	72	72	7.2		72	72	7.2	72	7.2		7.5	7.2	7.2	7.2	7.2						-		
Tensile-Tensile Fatique		Fiber Orienta-	0 1 V	0 3 9 +1	1450	1450	1450		145	+450	4450	1450	4450		+450	1150	4450	±450	0 5 7 #								
Test:	Material:	Specimen	Number F73-1	1 2 2 2	F23-8	01-064	1124-11	1 7	1 3 0 0	11-12-1	ا ا	F30-1	F33-1		2	F30-4	E33-7	1 1	F 3 3 - A	-		management of the second second					

R = +0.1	Prequency = 30 Hz	Function: Sing	Remarks																				and the second s
e de la companya de l La companya de la companya de			Residual Strength $(10^3 \text{ ps}1)$		£ 1		1	1	1 4	-	F. 45 an	1	1	1	ł :	1 1	44 44 44	21.2					
		•	Temp. Rise (*F)	+12	+8	+4	40	+2	+10	+13	+4	+6	+3	+ <u>1</u>	+7	+	0	+3					
			Cycles to Failure	51,800	90,	71,500	80,700	129,100	42,400	34,900	51,900	4,900	4,011,700	2,006,000	,571,	3,158,900	4,883,200	0					
			Max. Stress (& ult.)	75	75	7.5	75	75	70	70	7.0	70	70	65		65	65	65					
			Min. Stress (10 bal)	1.26	٠.	1.26	1.26	1.26	1.18	1.18	1,18		1.18	1.09	•	1.09	1.09	•					
tigue			Max. Stress	12.60	12.60	12.60	12.60	12.60	11.76	11.76	11.76		11.76	10.92	0.9	10.92	ō.0	10.92					
ensile F	T100/AFR800	777	Temp.	Γ	260	260	260	260	260	260	260	260	260	260	260	260	260	260					
Tensile-Tensile Fatigue	1: T300		Fiber Orienta-	±450	±45°	±45°	±45°	±45°	1450	±450	±450	±450	±45°	±450	±45°	±450	±45°	±450	Andreas de la company de la co				
Test:	Material:		Specimen	F30-5		1 1	F33-3	33-	F24-10	F25-4	F25-8	F32-1	11	F27-4	1.	F28-7	F32-4	F32-10					

R # +0.1	Prequency = 30 Hz	Pinction: Sine	Residual Strength (10 3 ps!) Remarks				44 64 28	an de st			gn 49 48					es de de				de de la constitución de la cons	THE RESIDENCE OF THE PROPERTY					The same and the s
			Temp. Rise (*F)	+7	+8	+16	+7	+7	+17	+5	9+	6+		+14	+12	+16	+13	+15								The state of the s
			Cycles to Failure	5,840,400	1,603,100	1,389,600	3,870,200	83,000	100,300	96,100	101,700	24.300		2,600	4,700		2,000	4,800								
			Max. Stress (& ult.)	45	45	45	45	55	55	55	5.5	9		7.0	7.0	7.0	70	70.								•
			Min. Stress (10 bel)	┞—	0.78	0.78	0.78	0.95	0.95	0.95	0.95	1.04	1	1.21	1.21	7	•	1.21								
Patrione	20.61.10		Max. Stress	7.79		7.79	7.79	9.53	9.53	5	9.53	10,39	ł	12.12	12.12	-		12.12								
- 1	1	07.77	Temp.		72	72	72	72	72	72	72	7.7		7.2	7.2	7.2	72	7.2								
al fanations	And Tensing to the Annual Control of the Ann	i	Fiber Orienta-	+450	1150	1450	1450	±45°	±450	1450	±450	+450		±450	1450	+450	1450	±450								
	Maror A.	T T T T T T T T T T T T T T T T T T T	Specimen	627-4	G29-8	630-8	G31-2	627-6	1 1	1 1	G31-7	630-7	1	614-3	615-6	615-8	:16-2	630-5				and the same of th	-		-	

Sic								Presidency at 30 ffx
	90557	***************************************						2
Piber Orienta-	Test Temp.	Max. Stress	Min. Stress	Max. Stress	Cycles	Temp. Rise	Residual Strength	Remarks
t.lo n +4.0	260	5.18	0.52	45	3,763,700			failed by operator error
±45°	260	5.18	0.52	45	+000,000,01	+3	12.23	
								managan and and extension of the party of th
±450	260	5.76	0.58	50	+000,000,01	+3	14.62	
0 - 1	0		6	ų	70.100	+26	1	
027	700		2 2 2	7.5	113.600	+29		
+450	260	6.34	0.63	55	44,300	+16		
+450	260		0.63	55	93,300	+6		
±450	260	6.93	0,69	09	11,600	+18	1 2	
±450	260	3.06	0.81	7.0	9,400	+19	1 4	
±450	260	•	0.81	0.2	3,200	+25	1	
450	260	8.06	0.81	7.0	2,300	+26	1	
±45C	260	8.06	•	70	-	+27	, I e	
1450	260	٠.		70	2,800	+23		
-								
						-		
-						ļ. 		
					-			
		-						

R = +0.1	Preguency = 10 Hs	Pinction, Sina	Max. Cycles Temp. Residual Stress to Rise Strength (4 ult.) Failure (7) (10 red) Hemarks	50% 2,557,000 +19	50% 6,650,560 +27	50% 2,396,300 +30	50% 3,060,200 +10	3,995,		55% 482,300 +20	55% 811,000 +39	55% 1,700,900 +17		65% 29,400 +31	65% 27,600 +	65% 106,800 +25			, 90, 0) - 20 ply	a		
			Max. Stress (% ult.)	50%	6,	2,	3,	3,9		5.8	5% 811	5% 1,700		5% 29	5% 27	3€ 2€			0, 0) 20	a		-
		1	Stress S (16 bel) (9	5.96	5.96 50%	96.	96.	96.		2	6.56 55%	S		5	7.75 65%	w			0,			
Tensile Fatigue	sic/5506		Test Max. Temp. Stress (*F) (10 mst)	72	72 59.6	72 59.	72 59.6	72 59.6		72 65.	4	72 65.6		72 77.5	72 77.5	72 77.5			0, 0, -45,			
Test: Tensile-Tensile	Material: SiC,		Fiber Epecimen Orienta- Number tion *	÷//a	G33-6 b/145/90	G40-7 D/±45/90	G41-4 D/±45/90	G44-4 0/145/90	-	p/±45/	34-2 0/145/	G40-3 0/±45/90		G34-5 0/±45/90	G39-8 D/±45/90	G44-8 5/±45/90			* (0, +45, -45			-

R = +0.1	Frequency = .30 Hz	Sine			alle de la companya d	ARREST CONTRACTOR OF THE STREET OF THE STREE	. A SECTION OF THE PROPERTY OF	de seguindas de companya de configuración de como de c			arana de la composição de					· · · · · · · · · · · · · · · · · · ·	aller de la company de la comp	en un de la companya		A CONTRACTOR OF THE PROPERTY O	despisables de constitución de la constitución despisables de constitución de constitución de constitución de c		
Andre delle de la come de la completa del la completa de la completa del la completa de la completa de la completa del la completa de la completa del la compl			Residual Strength		140 140 000	1	1			1 1	***			***		[]							
	And the second s		Temp. Rise	+12	+16	+2	+13		+1	+20	+18		+5	0	+16	+15							
			Cycles to Failure	413,200		١ -	1,148,400		98,200	140,800	474,500		5,700	{- ·	3.900	•j =	Į.			0) _s - 20 pl			
		2 21	Stress (1 ult.)	50%	50%	50%	50%		55%	55%	55%		809	803	809	809				0, 90,			_
***		- 277	Stress (10 psi)	5.86	5.86	5.86	5.86		6.45	6.45	6.45		7.03	0	7.03	7.03				, +45,			_
ractione			Stress (10 ³ psl)	58.6	58.6	53.6	58.6	- 1	64.5	64.5	64.5		70.3	70.3	70.3	70.3				0, -45			
1	5506	- Albert	Temp.	260	260	260	260		260	260	260		260	260	260	260				45, 0,			
	911 510/5506	Di Sar	Orienta- tion *	0/145/90	0/445/00	0/145/90	0/145/90	+,	0/-45/30	(±45)	0/145/00			0/145/90	0/445/90	0/145/90				0. +45,	1		
T TO THE MAN	שפרכני		Specimen Number	1	1	11	G44-7		Т	T	G40-1		7	G34-7	G35-7	640-9				*			

-		
87 80 87 80 87 80 87 80 66 70 66 70 66 70	7 7 7 7 7 7 7 7 7 7 7 9 9 9 9 9 9 9 9 9	2 8.68 0.87 2 8.68 0.87 2 8.68 0.87 60 6.10 0.61 60 6.57 0.66 60 6.57 0.66

*** Hin. Hax. Cycles Temp Residual Punction Sina ***	Test: Tensile-Tensile			Fatigue						R = +0.1 Frequency = .30 ftz
Hin. Hax. Cycles Temp. (77) Strendual (8 trust) Remarks (10 1941) (10 1241) (111) (77) (77) (77) (10 1941) Remarks (10 1941) (0.70 75 316,600 2 (0.70 75 316,600 2 (0.70 75 313,700 4 (0.80 85 2,300 2 (0.80 85 3,500 5 (0.80 85 3,500 5 (0.80 85 5,700 7 (0.80 85 5,700 7 (0.80 85 5,700 7 (0.80 85 5,700 7 (0.80 85 4,200 9 (0.80 95 13,000 5 (0.80 95 12,000 6	3	444				A				5
0.70 75 117,200 4 0.70 75 316,600 2 0.70 75 316,600 2 0.70 75 113,700 4 0.70 75 97,800 5 0.80 85 2,300 2 0.80 85 3,100 4 0.80 85 3,500 5 0.80 85 5,700 7 0.80 85 467,600 3 7.39 97.5 467,600 3 7.20 95 13,600 5 7.20 95 13,600 5 7.20 95 10,000,000+ 5 7.20 95 10,000,000+ 5 7.58 100 15,900 9 7.58 100 1,058,200 6 7.58 100 1,058,200 6 7.58 100 1,638,200 6	Orienta- Temp, Stress tion (*F) (10 mil	$\overline{}$	Str.	: 5	Min. Stress (10-bal)	Max. Stress (% ult.)	Cycles to Failure	Temp. Rise (°F)	Residual Strength (10 3 psi)	
0.70 75 316,600 2 0.70 75 98,700 8 0.70 75 113,700 4 0.70 75 91,800 5 0.80 85 2,300 4 0.80 85 6,100 6 0.80 85 6,100 6 0.80 85 3,500 5 1.39 97.5 800 3 2.73 97.5 467,600 3 2.73 97.5 467,600 3 2.73 97.5 467,600 3 3.720 95 13,600 5 3.720 95 10,000,000+ 8 3.720 95 10,000,000+ 5 3.720 95 10,000,000+ 5 3.758 100 10 3.758 100 10 3.758 100 11,058,200 9	260		7.0	4	0.70	75	117,200	4	* *	
0.70 75 98,700 8 0.70 75 113,700 4 0.80 85 2,300 5 0.80 85 3,100 4 0.80 85 3,100 6 0.80 85 5,700 5 2 7.39 97.5 467,600 3 2 7.39 97.5 467,600 3 2 7.39 97.5 467,600 3 2 7.39 97.5 467,600 3 3 7.20 95 13,600 5 3 7.20 95 10,000,000 5 3 7.20 95 10,000,000 5 3 7.58 100 10 4 5 10,000 0	1450 260 7.04		7.0	4	•	75	316,600	2	1	
0.70 75 113,700 4 0.80 85 2.300 2 0.80 85 3,100 4 0.80 85 3,500 5 0.80 85 5,700 7 2 7.39 97.5 800 3 2 7.39 97.5 467,600 3 2 7.39 97.5 467,600 3 2 7.39 97.5 46,200 9 3 7.20 95 13,600 5 3 7.20 95 12,000 10 3 7.20 95 10,000,000+ 8 79.6 3 7.28 100 10 4 5 10,000 9 5 7.58 100 1,058,200 9 7	±45° 260 7.04		7.0	ť	•	75	8,70	8	71 - 40 - in	
0.80 85 2.300 2 0.80 85 2.300 2 0.80 85 3,100 4 0.80 85 3,100 6 0.80 85 3,500 5 0.80 85 3,500 5 0.80 85 5,700 7 2 7.39 97.5 467,600 3 2 7.39 97.5 467,600 3 3 7.20 95 13,600 5 3 7.20 95 10,000,000+ 8 78.7 3 7.20 95 10,000,000+ 8 79.6 2 7.58 100 10 2 7.58 100 1,058,200 6 2 7.58 100 1,058,200 6 3 7.58 100 1,058,200 6	±45° 260 7.04		7.0	4	. 7		13,	4	1	
0.80 85 2,300 2 0.80 85 3,100 4 0.80 85 3,100 4 0.80 85 3,500 5 0.80 85 5,700 7 0.80 85 5,700 7 2 7.39 97.5 800 3 2 7.39 97.5 467,600 3 3 7.20 95 13,600 5 3 7.20 95 10,000,000+ 8 78.7 3 7.20 95 10,000,000+ 5 2 7.58 100 10 3 7.58 100 1,058,200 9 2 7.58 100 1,058,200 9 2 7.58 100 1,058,200 9	±45° 260 7.04		7.04		0.7		4	5	- ∤ [
0.80 85 2.300 2 0.80 85 3,100 4 0.80 85 3,100 6 0.80 85 3,500 5 0.80 85 5,700 7 2 7.39 97.5 800 3 2 7.39 97.5 4,200 9 3 7.20 95 13,600 5 3 7.20 95 10,000,000+ 8 78.7 3 7.20 95 10,000,000+ 5 2 7.58 100 0 2 7.58 100 1,250 9 2 7.58 100 0 3 7.58 100 0 4 20 95 1,058,200 9 5 7.58 100 1,058,200 9										
0.80 85 3,100 4 0.80 85 6,100 6 0.80 85 5,700 7 2 7.39 97.5 800 3 2 7.39 97.5 467,600 3 2 7.39 97.5 467,600 3 3 7.20 95 13,600 9 3 7.20 95 12,000 0 3 7.20 95 10,000,000+ 8 78.7 3 7.20 95 10,000,000+ 8 7.56 4 7.58 100 0 9 5 7.58 100 1,200 1 6 7.58 100 0 1 7.58 100 1,200 0 1 7.58 100 7,	±45° 260 7.98	7	•	9	•	85	Í	2	1 [elektristen en e
0.80 85 6,100 6 0.80 85 3,500 5 0.80 85 3,500 5 0.80 85 5,700 7 2 7.39 97.5 467,600 3 2 7.39 97.5 467,600 3 3 7.20 95 13,600 5 3 7.20 95 12,000 0 3 7.20 95 12,000 1 3 7.20 95 10,000,000+ 8 78.7 3 7.20 95 10,000,000+ 5 2 7.58 100 10,000,000+ 5 2 7.58 100 1,000 1 2 7.58 100 1,000 1 2 7.58 100 1,058,000 6 2	260	7.	•	~	•	85	•	4		
0.80 85 3,500 5 0.80 85 5,700 7 2 7.39 97.5 800 3 2 7.39 97.5 467,600 3 3 7.20 95 13,600 5 3 7.20 95 12,000 0 3 7.20 95 12,000 10 3 7.20 95 12,000 10 2 7.58 100 10 2 7.58 100 1,200 1 2 7.58 100 1,200 1 2 7.58 100 0 2 7.58 100 1,200 1 2 7.58 100 0 2 7.58 100 1 3	±45° 260 7.98	7.			•	85	-	9	•	
0.80 85 5,700 7 7.39 97.5 800 3 7.39 97.5 467,600 3 7.39 97.5 4,200 9 7.20 95 13,600 5 7.20 95 10,000,000+ 8 78.7 7.20 95 10,000,000+ 8 78.7 7.20 95 10,000,000+ 5 7.58 100 15,900 9 7.58 100 1,200 1 7.58 100 1,200 1 7.58 100 1,200 1 7.58 100 1,200 1 7.58 100 7,58 100 1,200 1 7.58 100 1,638,200 5 7.58 100 7,638,200 5	±45° 260 7.98	7.	7.98		•	85	-	5	1	
7.39 97.5 800 3 7.39 97.5 467,600 3 7.39 97.5 4,200 9 7.20 95 13,600 5 7.20 95 10,000,000+ 8 78.7 7.20 95 10,000,000+ 8 78.7 7.20 95 10,000,000+ 8 79.6 7.58 100 15,900 9 7.58 100 1,200 1 7.58 100 1,200 1 7.58 100 1,200 1 7.58 100 1,200 1 7.58 100 7,58 100 1 7.58 100 7,638,200 6 7.58 100 7,638,000 5	±45° 260 7.98	7.9	6.		ω.		-	7	1	
7.39 97.5 800 3 7.39 97.5 467,600 3 7.39 97.5 4,200 9 7.20 95 13,600 5 7.20 95 10,000,000+ 8 78.7 7.20 95 10,000,000+ 5 7.20 95 10,000,000+ 5 7.58 100 15,900 9 7.58 100 1,200 1 7.58 100 1,200 1 7.58 100 1,200 1 7.58 100 7,638,000 5						-				
7.39 97.5 467,600 3 7.39 97.5 4,200 9 7.20 95 13,600 5 7.20 95 10,000,000+ 8 78.7 7.20 95 12,000 10 7.20 95 10,000,000+ 5 7.58 100 15,900 9 7.58 100 15,900 9 7.58 100 100 1 7.58 100 1,200 1 7.58 100 1,200 1 7.58 100 7,638,000 5 7.58 100 7,638,000 5	0/145/90 72 73.92	73.9	σ.		•	7.	008	3·	1	
7.39 97.5 4,200 9 7.20 95 13,600 5 7.20 95 10,000,000+ 8 78.7 7.20 95 12,000 10 7.20 95 12,000 10 7.20 95 10,000,000+ 5 79.6 7.58 100 15,900 9 7.58 100 300 1 7.58 100 1,200 1 7.58 100 7,638,200 6 7.58 100 7,638,200 5	72 73.9	73.9	3.9		. 3	7.	67,	3	•	
7.20 95 13,600 5 7.20 95 500 0 7.20 95 10,000,000+ 8 78.7 7.20 95 12,000 10 7.20 95 10,000,000+ 5 79.6 7.58 100 15,900 9 7.58 100 1,200 1 7.58 100 1,200 1 7.58 100 7,638,200 6 7.58 100 7,638,200 5 7.58 100 7,638,200 5	0/145/90' 72 73.92	2 73.9	3.9		ъ.	7.	-	6	1	
7.20 95 13,600 5 7.20 95 10,000,000+ 8 78.7 7.20 95 12,000 10 7.20 95 10,000,000+ 5 79.6 7.58 100 15,900 9 7.58 100 15,900 9 7.58 100 1,200 1 7.58 100 1,200 1 7.58 100 7,638,000 5 7.58 100 7,638,000 5										
7.20 95 500 0 7.20 95 10,000,000+ 8 78.7 7.20 95 12,000 10 7.20 95 10,000,000+ 5 79.6 7.58 100 15,900 9 7.58 100 300 1 7.58 100 1,200 1 7.58 100 1,200 1 7.58 100 7,638,200 5 7.58 100 7,638,200 5	72 72.0	72 72.0	0	3			3,	5	i i	
7.20 95 10,000,000+ 8 78.7 7.20 95 12,000 10 7.20 95 10,000,000+ 5 79.6 7.58 100 15,900 9 7.58 100 1,200 1 7.58 100 1,200 1 7.58 100 1,200 1 7.58 100 7,638,200 6 7.58 100 7,638,200 5	0/145/90' 72 72.0	72 73.0	0	3	. 2		200	0		
7.20 95 12,000 10 7.20 95 10,000,000+ 5 79.6 7.58 100 15,900 9 7.58 100 1,200 1 7.58 100 1,058,200 6 7.58 100 7,638,200 5	0/#45/90' 72 72.03	72.0	٥.	~	.2	95	0,000,	ဆ	8.7	
2 7.20 95 10,000,000+ 5 79.6 2 7.58 100 15,900 9 2 7.58 100 1,200 1 2 7.58 100 1,058,200 6 2 7.58 100 7,638,000 5	0/145/90' 72 72.0	72.		3	. 2		2,	10	1	
2 7.58 100 15,900 9 - 2 7.58 100 1,200 1 2 7.58 100 1,058,200 6 2 7.58 100 7,638,000 5	b/±45/90' 72 72.0	72 72.	2.		2	95	0,000,	2	9.6	адар қолданда андал обий менейнден мене дей карама айлам жұрында қазақсында жұрында байда жұрында жарында жары
2 7.58 100 15,900 9 - 2 7.58 100 1,200 1 2 7.58 100 1,058,200 6 - 2 7.58 100 7,638,000 5 -										
2 7.58 100 300 1 2 7.58 100 1,058,200 6 2 7.58 100 7,638,000 5	0/145/90' 72 75.8	2 75.8	5.8	2	ıΩ	100	5,	6/	1	
7.58 100 1,200 1 7.58 100 1,058,200 6 7.58 100 7,638,000 5	0/145/90' 72 75.82	2 75.8	5.8		5		300	ı	1	
7.58 100 1,058,200 6 -	0/145/90 72 75.8	2 75.8	5.8	2	•	100	۱ ٦	-1	1	
7.58 100 7,638,000 5	72 75.8	75.8	ω,	~	•		,058,	9	+ 1	
	•	72 75.	•	7	•	100	,638	5		- Language

(0, +45, -45, 0, 0, -45, +45, 0, 90, 0)_s - 20 ply

Material: HyE	2034D							Frequency #,30 Hz
								Function: Sine
Fiber Orienta-	Tout Tout	Max. Stress	Min. Stress (10 tot)	Max. Stress (% ult.)	Cycles to Failure	femp. Riss (*F)	Residual Strength (10 ³ psi)	Resarks
0/145/90	7.2	68.24	6.82	90	10,000,000+	3	76.50	
0/145/90	72	38.83	3.88	09	10,000,000+	Ţ	61.34	de distribute de l'andre de l'Arthur de l'Arthur de désignant en marche de l'Arthur de l'Arthur de l'Arthur de
X /	- [Ì		1	e de la companya de l
0/445/90	72	45.30	4.53	7.0	10,000,000+	2	59.93	
0/*45/96	7.2	51.78	5.18	80	10,000,000+	2	66.06	
E /								
0/14/2/9/0	72	55.01	5.50	85	<100	1 1		
								Andrew Henry Durch and Control of Market and Alfan age - property and the state of

Stresses based $^{1}(0, +45, -45, 0, 0, -45, +45, 0, 90, 0)_{\rm S}$ - 20 ply 2 These specimens had a 0.1935 inch (0.491 cm) hole in center of test section. on net cross-sectional area.

Test:	Tensile-Tensile	ensile F	Fatique				Open design and the state of th	The state of the s	R & +0.1
Materials	A1: T300/V378A	7378A							Frequency = 30 Hz
									Punction: Sine
Specimen	Piber Orienta-	Tent.	Max. Stress	Min. Stress	Max. Stress	Cycles to Feilure	Temp. Rise	Strength	**************************************
The state of the s	4450	7.5	15 07	09	7.5	31.000	8		
17-2	4.450	72	15.97	1.60	75	24,200	6		, proposition representation of the production of the representation of the representat
110-3	1450	72		1.60	75	9,100	7	100 and 100 an	
111-6	1450	72	15.97	1.60	75	20,500	8	100 - CO -	
122-C	±450	72	15.97	1.60	7.5	9,400	6		
13-2	±450	7.2	14.90	1.49	70	47,600	9	94 PG 168	
17-3	±450	72		1.49	70	92,700	9	27 12 00	
110-6	±,150	72		1.49	70	009'19	9	And the case	
T11-2	±450	72	14.90	1.49	70	82,700	9		
13-9	±45°	72	13.84	1.38	65	582,500	5		
17-6	±450	72	13.84	1.38	65	006'697	4	-	
110-2	±45°	72	13.94	1.38	65	210,000	8		
111-3	1450	72	13.34		65	433,000	5	1	
122-4	±45°	72	13.84	1.38	. 59	1,020,700	9	-	
				The same of the sa					
13-8	±457	350	13.70	1.37	85	9,400	14		
16-1	±450	350	13.70	1.37	85	3,900	19	-	aginagonumangepeninamintelija «Silati anto governijanis» istorijanja privajajijiji provina ostav ve rezimpeni
17-1	±450	350	13.70	1.37	35	200	z,	-	A province and a simulation of the speciments of the state of the stat
110-8	±45°	350	13.70	1.37	85	10,300	5 ₹		en e
122-3	±45c	350	1.	1.37	85	12,500	13		
									дайный админалдинай надагорга админентациям правителем и поставления поставления поставления поставления поста
16-7	±45°	350	12.90	1.29	80	59,300	6	Aug des 180	
110-1	±45°	350	12.90	1.29	80	50,500	9	-	
11.11	145°	350	12.90	1.29	80	43,100	ស	,	g describe productions and the state of the
122-8	±45°	350	12.90	1.29	80	56,700	6	1 1	The state of the s

THE STATE OF THE S

Platerial: T300(V378A Piber feat floor tion tion tion tion tion tion tion tion	Test:	Tensile-Tensile		Fatique						R * +0.1
Section Cinet Table Section Table Table	Mater	ial: T300/V								30
Speciment Fight Way. Cycle Right Resident Resident Resident Particle Particl		1								
13-5 $\pm 45^\circ$ 350 12.09 1.21 75 238,300 11 17-5 $\pm 45^\circ$ 350 12.09 1.21 75 383,000 6 110-4 $\pm 48^\circ$ 350 12.09 1.21 75 383,000 6 111-7 $\pm 45^\circ$ 350 12.09 1.21 75 383,000 6 112-7 $\pm 45^\circ$ 350 12.09 1.21 75 384,600 9 112-7 $\pm 45^\circ$ 350 12.09 1.21 75 384,600 9 112-7 $\pm 45^\circ$ 350 12.09 1.21 75 384,600 9 112-7 $\pm 45^\circ$ 72 95 8 80 4,410,000 41 113-7 $\pm 45^\circ$ 72 95 8 80 53,400 30 133-7 $\pm 45^\circ$ 9.58	Specimen			Max. Stress	Min. Stress (10-pai)	Max. Stress (& ult.)	Cycles to Pailure	Temp. Rise (°F)	Residual Strength (10 ³ psil	Resertes
17-5 $\pm 45^\circ$ 350 12.09 1.21 75 376,400 8 110-4 $\pm 45^\circ$ 350 12.09 1.21 75 383,000 6 111-7 $\pm 45^\circ$ 350 12.09 1.21 75 383,000 6 112-7 $\pm 45^\circ$ 350 12.09 1.21 75 354,600 9 115-4 $0.745/90^\circ$ 72 95.78 9.58 80 1,800 32 113-7 $0.745/90^\circ$ 72 95.78 9.58 80 1,800 32 113-7 $0.745/90^\circ$ 72 95.78 9.58 80 3,400 33 113-7 $0.745/90^\circ$ 72 95.78 9.58 80 3,400 30 113-7 $0.745/90^\circ$ 72 92.78 77.5 3,269,500 20 71,130 80 10,000,000	13-5	±45°	Γ	12.09	1.21	75	238,300	11	****	
110-4 $\pm 45^\circ$ 350 12.09 1.21 75 383,000 6 111-7 $\pm 45^\circ$ 350 12.09 1.21 75 356,600 8 112-7 $\pm 45^\circ$ 350 12.09 1.21 75 354,600 9 113-4 $0.745/90^4$ 72 95.78 9.58 80 1,800 32 113-4 $0.745/90^4$ 72 95.78 9.58 80 3,000 41 113-7 $0.745/90^4$ 72 95.78 9.58 80 3,000 32 113-7 $0.745/90^4$ 72 95.78 8.0 3,000 33 8-1 113-7 $0.745/90^4$ 72 92.78 9.28 77.5 3,299,500 20 8-1 130-7 $0.745/90^4$ 72 92.78 9.28 77.5 10,000,000+ 25 104,36	17-5	+450	350	12.09	1,21	75	276,400	8		
111-7 ±45° 350 12.09 1.21 75 565,600 8 122-7 ±45° 350 12.09 1.21 75 354,600 9 112-7 ±45° 350 12.09 1.21 75 354,600 9 112-7 0,45,500 ¹ 72 95.78 9.58 80 4,481,000 41 113-7 0,45,900 ¹ 72 95.78 9.58 80 53,400 33 113-7 0,45,900 ¹ 72 95.78 9.28 80 53,400 33 113-7 0,445,900 ¹ 72 92.78 9.28 80 53,400 33 113-7 0,445,901 72 92.78 9.28 77.5 92,600 30 Failed due 139-6 0,445,901 72 92.78 9.28 77.5 10,000,000+ 25 104,36 113-7	110-4	1450	350	12.09	1.21	75	383,000	9		
145° 350 12.09 1.21 75 354.600 9 $0.745.90^{1}$ 72 95.78 9.58 80 4,481,000 41 $0.745.90^{1}$ 72 95.78 9.58 80 4,481,000 41 $0.745.90^{1}$ 72 95.78 9.58 80 53,400 33 $0.745.90^{1}$ 72 95.78 9.28 77.5 3,269,500 20 $0.745.90^{1}$ 72 92.78 9.28 77.5 3,269,500 20 Pailed due $0.745.90^{1}$ 72 92.78 9.28 77.5 3,269,500 20 Pailed due $0.745.90^{1}$ 72 92.78 9.28 77.5 3,190,200 30 Pailed due $0.745.90^{1}$ 72 92.78 9.28 77.5 10,000,000+ 25 Pailed due $0.745.90^{1}$ 72 89.79 <td< td=""><td>111-7</td><td>-450</td><td>350</td><td>12.09</td><td>1.21</td><td>75</td><td>265,600</td><td>8</td><td></td><td></td></td<>	111-7	-450	350	12.09	1.21	75	265,600	8		
112-7 0.745/90 ¹ 72 95.72 9.58 80 1,800 32 1135-4 0.745/90 ¹ 72 95.78 9.58 80 3,000 34 1136-5 0.745/90 ¹ 72 95.78 9.58 80 3,000 33 1137 0.745/90 ¹ 72 92.78 9.28 77.5 3,269,500 20 1137 0.745/90 ¹ 72 92.78 9.28 77.5 3,269,500 20 1139-7 0.745/90 ¹ 72 92.78 9.28 77.5 3,269,500 30 1139-7 0.745/90 ¹ 72 92.78 9.28 77.5 3,269,500 30 1140-7 0.745/90 ¹ 72 92.78 9.28 77.5 3,190,000 33 1139-7 0.745/90 ¹ 72 92.78 9.28 77.5 10,000,000+ 25 104.36 1139-7 0.745/90 ¹ 72 89.79 8.98 75 10,000,000+ 25 114.20 1139-7 0.745/90 ¹ 72 83.80 8.38 70 10,000,000+ 25 114.20	122-7	±45°	350	12.09	1.21	75	354,600	6		
112-7 0/445/90 ¹ 72 95.8 80 1,800 32 135-4 0/445/90 ¹ 72 95.78 9.56 80 4,481,000 41 136-5 0/445/90 ¹ 72 95.78 9.56 80 3,000 35 135-7 0/445/90 ¹ 72 95.78 9.28 77.5 1,300 8 Failed due 135-5 0/445/90 ¹ 72 92.78 9.28 77.5 1,300 8 Failed due 135-5 0/445/90 ¹ 72 92.78 9.28 77.5 3,269,500 20 Failed due 139-7 (/445/90 ¹ 72 92.78 9.26 77.5 10,000,000+ 25 Failed due 139-7 (/445/90 ¹ 72 92.78 9.26 75 10,000,000+ 25 164.36 130-7 0/45/90 ¹ 72 89.79 8.96 75 10,000,00										
135-4 0/45/90¹ 72 95.78 9.58 80 4,481,000 41 136-5 0/445/90¹ 72 95.78 9.58 80 3.000 35 133-7 0/445/90¹ 72 95.78 9.58 80 53,400 33 135-8 0/445/90¹ 72 92.78 9.28 77.5 1,300 8 Failed due 135-5 0/445/90¹ 72 92.78 9.28 77.5 1,300 8 Failed due 139-7 (/445/90¹ 72 92.78 9.28 77.5 10,000,000+ 25 Failed due 139-7 (/445/90¹ 72 92.78 77.5 10,000,000+ 25 Failed due 125-6 6/45/90¹ 72 92.78 77.5 10,000,000+ 25 104.36 130-7 0/45/90¹ 72 89.79 8.98 75 10,000,000+ 25	112-7	0/465/901	72	95.78	9.58	80	1,800	32		
136-5 0/45/90 ¹ 72 95.78 9.58 80 3.000 35 133-7 0/45/90 ¹ 72 95.78 9.58 80 53,400 33 135-5 0/45/90 ¹ 72 92.78 9.28 77.5 1,300 8 Failed due 137-6 0/45/90 ¹ 72 92.78 9.28 77.5 3,269,500 20 Failed due 139-7 (/45/90 ¹) 72 92.78 9.28 77.5 10,000,000+ 25 Failed due 125-6 0/45/90 ¹ 72 92.78 9.20 77.5 10,000,000+ 25 104.36 137-7 0/45/90 ¹ 72 89.79 8.98 75 10,000,000+ 25 137-7 0/45/90 ¹ 72 83.80 8.38 70 10,000,000+ 25 139-7 45,90 8.38 70 10,000,000+ 25 114.20 <td>135-4</td> <td>0/145/90^L</td> <td>72</td> <td>95.78</td> <td>9.58</td> <td>80</td> <td>4,481,000</td> <td>41</td> <td></td> <td></td>	135-4	0/145/90 ^L	72	95.78	9.58	80	4,481,000	41		
133-7 0/445/90t 72 95.78 9.58 80 53,400 33 135-5 0/445/90t 72 92.78 9.28 77.5 1,300 8 Failed due 137-6 0/445/90t 72 92.78 9.28 77.5 3,266,500 20 Failed due 137-7 0/445/90t 72 92.78 9.28 77.5 10,000,000+ 25 164.36 125-6 0/45/90t 72 92.78 8.98 75 10,000,000+ 25 164.36 125-6 0/45/90t 72 89.79 8.98 75 10,000,000+ 25 137-7 0/45/90t 72 89.79 8.98 75 10,000,000+ 25 113-7 0/45/90t 72 83.80 8.38 70 10,000,000+ 25 114.20 129-7 0/45/90t 72 83.80 8.	136-5	0/445/90 ^T	72	95.78	•	80	3.000	35	***	
135-5 0/445/90 ¹ 72 92.78 9.28 77.5 1,300 8 Failed due 137-6 0/445/90 ⁴ 72 92.78 9.28 77.5 3,269,500 20 Failed due 139-7 1/445/90 ⁴ 72 92.78 9.28 77.5 10,000,000+ 25 104.36 140-7 0/445/90 ¹ 72 89.79 8.98 75 10,000,000+ 13 122.65 126-4 0/45/90 ¹ 72 89.79 8.98 75 10,000,000+ 13 122.65 137-7 0/45/90 ¹ 72 83.80 8.38 70 3,632,600 55 113-7 0/45/90 ¹ 72 83.80 8.38 70 10,000,000+ 25 113-7 0/45/90 ¹ 72 83.80 8.38 70 10,000,000+ 25 114.20 129-7 0/45/90 ¹ 72 83.80 9.38 70 10,000,000+ 25 114.20 1 (0, +45, -45, 0, 0, 0, -45, +45, 0, 90, 0), -45, -20 ply	133-7	0/±45/90"	72	95.78	9.58	80	53,400	33		
135-5 0/445/90 ⁴ 72 92.8 77.5 3,269,500 20 Failed due 137-6 0/445/90 ⁴ 72 92.78 9.28 77.5 3,269,500 20 Failed due 139-7 (/445/90 ⁴ 72 92.78 9.28 77.5 10,000,000+ 25 104.36 140-7 (/445/90 ⁴) 72 89.79 8.98 75 3,190,200 33 125-6 (/445/90 ⁴) 72 89.79 8.98 75 10,000,000+ 13 122.65 137-7 (/45/90 ⁴) 72 89.79 8.98 75 10,000,000+ 55 113-7 (/45/90 ⁴) 72 83.80 8.38 70 10,000,000+ 25 113-7 (/45/90 ⁴) 72 83.80 8.38 70 10,000,000+ 25 129-7 (/45/90 ⁴) 72 83.80 8.38 70 10,000,000+ 25 1 (/45/90 ⁴) 72 445, 0, 0, 0, -455, 445, 0, 00, 0, -455, 0										
137-6 0/445/901 72 92.78 9.28 77.5 3,269,500 20 Failed due 139-7 1/445/901 72 92.78 9.28 77.5 10,000,000+ 25 164.36 Failed due 140-7 0/445/901 72 92.78 9.26 77.5 10,000,000+ 25 164.36 Failed due 125-6 6/45/901 72 89.79 8.98 75 3,190,200 33 136-4 0/45/901 72 89.79 8.98 75 10,000,000+ 55 137-7 0/45/901 72 83.80 8.38 70 10,000,000+ 25 114.20 113-7 0/45/901 72 83.80 8.38 70 10,000,000+ 25 114.20 129-7 0/45/901 72 445, 0, 90, 0), -45, 445, 0, 90, 0), -25, 12.20 20.21	ــــــــــــــــــــــــــــــــــــــ	0/t45/90 ^T	72	92.78	9.28	77.5	1,300	8		
$(\frac{745}{90^4}, \frac{1}{72})$ 92.78 92.88 77.5 99,600 30 $0\frac{1}{45}$ 72 92.78 9.25 77.5 10,000,000+ 25 $(\frac{1}{45}$ 72 89.79 8.98 75 3,190,200 33 $(\frac{1}{45}$ 72 89.79 8.98 75 10,000,000+ 13 $(\frac{1}{45}$ 72 89.79 8.98 75 3,985,800 55 $(\frac{1}{45}$ 72 83.80 8.38 70 3,632,600 21 $(\frac{1}{45}$ 72 83.80 8.38 70 10,000,000+ 25 $(\frac{1}{45}$ -45, 0, 0, 0, -45, +45, 0, 90, 0), -25, +45, 0, 90, 0), -20 pty 20 pty 20 pty	-	0/445/901	72	92.78	9.28	77.5	3,269,500	20	age and seri	due
$0/\pm45/90^{1}$ 72 92.78 9.20 77.5 $10,000,000+$ 25 $0/\pm45/90^{1}$ 72 89.79 8.98 75 $10,000,000+$ 13 $0/\pm45/90^{1}$ 72 89.79 8.98 75 $10,000,000+$ 13 $0/\pm45/90^{1}$ 72 89.79 8.96 75 $10,000,000+$ 55 $0/\pm45/90^{1}$ 72 83.80 8.38 70 $3.632,600$ 21 $0/\pm45/90^{1}$ 72 83.80 8.38 70 $10,000,000+$ 25 $0/\pm45/90^{1}$ 72 83.80 8.38 70 $10,000,000+$ 25 $10,000,000+$	139-7	1./*45/90*	72	92.78	9.28	77.5	009'66	30		
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	140-7	0/445/901	72	92.78	9.20	77.5	10,000,000+	25	164.36	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$										
0,45/90¹ 72 89.79 8.98 75 10,000,000+ 13 0,45/90¹ 72 89.79 8.98 75 3,985,800 55 0,445/90¹ 72 83.80 8.38 70 3,632,600 21 0,445/90¹ 72 83.80 8.38 70 10,000,000+ 25 2 6,445, 0. 0, -45, 445, 0. 90, 0. -20 ply -	125-6	C/±45/90	72	89.79		75		33		
$0, \pm 45/90^{1}$ 72 89.79 8.90 75 $3.905,800$ 55 $0, \pm 45/90^{1}$ 72 83.80 8.38 70 $10,000,000+$ 21 $0, \pm 45/90^{1}$ 72 83.80 8.38 70 $10,000,000+$ 25 $1, \pm 45/90^{1}$ <td< td=""><td>136-4</td><td>0/-45/901</td><td>72</td><td>69.79</td><td>8.98</td><td>75</td><td>10,000,000+</td><td>13</td><td>122.65</td><td>er en en</td></td<>	136-4	0/-45/901	72	69.79	8.98	75	10,000,000+	13	122.65	er en
0,±45/90 ¹ 72 83.80 8.38 70 3.632,600 21 0,±45/90 ¹ 72 83.80 8.38 70 10,000,000+ 25 = (0, +45, -45, 0, 0, -45, +45, 0, 90, 0) - 20 ply	137-7	10, ±45/901	72	89.79	8.93	75	3,985,800	55	1	
0,45/90¹ 72 83.80 8.38 70 3.632,600 21 0,445/90¹ 72 83.80 8.38 70 10,000,000+ 25 1 (0, +45, -45, 0, 0, -45, +45, 0, 0, 0), -20 ply 20 ply										
0,±45/90 ¹ 72 83.80 8.38 70 10,000,000+ 25 1 (0, +45, -45, 0, 0, -45, +45, 0, 90, 0) - 20 ply	113-7	0/445/901	72	83.80	8.38	70	3,632,600	21	1	
1 (0, +45, -45, 0, 0, -45, 445, 0, 90, 0) -	129-7	0/445/901	72	83.80	8.38	7.0	10,000,000+	25	114.20	
(0, +45, ~45, 0, 0, -45, +45, 0, 90, 0)]										
(0, +45, -45, 0, 0, -45, +45, 0, 90, 0) 3 -										
2		9		0	l J	(0				
					1 1					

Test:	Tensile-Tensile Fatique	ensile !	Patique						R = +0.1
Material:	al: T300/V378A	7378A							Prequency = .30 Hz
	1								Function: Sine
Specimen	Piber Orienta-	Tonp.	Max. Stress	Min. Stress (10-bet)	Max. Stress (1 ult.)	Cycles to Failure	Yemp. Rise (*F)	Residual Strength	Renarks
135-6	0/*45/901	350	-	9.01	85	328,700	42	en en -m	
136-6	0/45/901	350	90.10	9.01	35	613,500	24		
	0/*25/901	350	90.10	9.01	35	960,500	34		
114-6	0/445/901	350	87.45	8.75	32.5	1,229,400	38		
136-7	0/145/901	350	87.45	8.75	82.5	2,128,300	20		overheated to 525°F
139-10	0/445/901	350	37.45	0.75	82.5	332,400	17		
112-3	0/+45/901	350	84.80	0.43	30	102,400	52		
113-8	b/t45/901	350	84.80	8.43	30	000,099	29	***************************************	
133-8	0/145/90 ¹	350	84.80	8.48	30	626,100	22		
139-8	0/±45/901	350	84.80	3.48	80	432,200	32	1	
140-3	5/ 1 45/90 ¹	350	34.50	3.43	80	2,320,600	54	1	
113-2	2/445/9017	72	33.45	8.85	95	260,100	59	-	
114-2	0/±45/90 1 ,2	72	88.45	8.85	95	2,191,900	45	1	
136-1	0/445/9012	72	88.45	8.85	95	2,012,300	75	1	
139-1	0/1:15/5013	72	88.45	2.85	95	225,500	57		
113-1	D/*45/90 ^{1,2}	72	83.79	8,38	36	61,300	53		
I14-1	0/*45/901/2		83.79	8.38	06	932,600	54		
137-1	0/±45/9017	72	83.79	0.33	90	1,587,800	32	1	
112-2	0/*45/9012	7.2	79.14	7.91	65	265,700	42	ì	
128-2	0/445/9013	72	79.14	7.91	85	1,252,600	50	-	
138-2	0/445/9042		79.14	7.91	85	1,024,200	53	1	
140-1	D/#45/9017	72	79.14	7.91	85	2,399,300	52		

^{1(0, +45, -45, 0, 0, -45, 45, 0, 90, 0)&}lt;sub>s</sub> - 20 ply

福祉日 さいとう こうしゅう

²These specimens had a 0.1935 inch (0.491 cm) hole in center of test section. Stresses based on net cross-sectional area.

Naterial: HyE 10765 Specimen Fiber femp. 13-5	Test:	Tensile-Tensile	ensile F	Patigue						R = +0.1
Species Fiber (**) Fact (**) Min. (**) Hin. (**) Hin. (**) Cycles Rices (**) Regidul (**) Regidul (**) 39-cies Cienta (**) 11, 2041 (10, 241) (10, 11) (**)	Materi	tal: HyE	10765							30
Specimen Tiber 1 Year 1 Wax. bits as a began stress and between the control of the										Function: Sine
Manual		Fiber	Test	Hax.	Min.	Hax.	Cycles	Temp.	Residual	
33-5 #45 72 17.82 1.78 80 13,600 9 J6-1 #45 72 17.82 1.78 80 1,700 11 J3-4 #45 72 17.82 1.78 80 6,500 9 J3-6 #45 72 17.82 1.78 80 6,500 9 J11-7 #45 72 17.82 1.78 80 6,500 9 J3-6 #45 72 17.82 1.78 80 6,500 9 J3-7 #45 72 15.60 1.56 70 200,200 20 J10-5 #45 72 15.60 1.56 70 153,800 20 J10-5 #45 72 15.60 1.56 70 153,800 12 J10-5 #45 72 14.48 1.45 65	Specimen Number	Urienta- tion		(10 ³ ps1)	(10 ³ psi)	(* ult.)	Pailure	(. 6)	(10 ³ pst)	Remarks
Joseph Larger 17.82 1.78 80 1,700 11 JJ-4 445 72 17.82 1.78 80 5,400 6 JJ1-7 445 72 17.82 1.78 80 6,500 9 JJ1-7 445 72 17.82 1.78 80 8,700 9 J4-5 12 15.60 1.56 70 120,200 24 J5-6 1.56 70 13,800 24 J10-5 445 72 15.60 1.56 70 13,800 24 J10-5 445 72 15.60 1.56 70 13,800 24 J12-5 445 72 14.48 1.45 65 1,202,100 7 J12-7 445 1.48 1.45 65 1,005,800 4 J10-7	J3-5	±45	72	17.82	1.78	80	11,600	თ		
445 72 17.82 1.78 80 5,400 6 445 72 17.82 1.78 80 6,500 9 445 72 17.82 1.78 80 6,500 9 445 72 15.60 1.56 70 200,300 8 445 72 15.60 1.56 70 10,200 24 5 445 72 15.60 1.56 70 12,600 12 5 445 72 15.60 1.56 70 138,800 20 5 445 72 14.48 1.45 65 883,600 3 445 72 14.48 1.45 65 883,600 3 445 72 14.48 1.45 65 1.405,800 8 445 72 14.48 1.45<	J6-1	±4 5	72	17.82	1.78	80	1,700	11	1 1 1	
Ja-6 445 72 17.82 1.78 80 6,500 9 J11-7 445 72 17.82 1.78 80 8,700 9 J4-5 445 72 15.60 1.56 70 200,300 8 J6-6 445 72 15.60 1.56 70 1510,200 24 J8-5 72 15.60 1.56 70 153,800 20 J12-5 445 72 15.60 1.56 70 188,800 20 J12-5 445 72 14.48 1.45 65 1,202,100 7 J12-7 445 72 14.48 1.45 65 1,005,800 8 J12-7 445 12 14.48 1.45 65 1,005,800 8 J12-7 14.48 1.45 65 1,005,800 8	37-4	± 45	72		•	80	•	9	1	
J11-7 445 72 17.82 1.78 80 8,700 9 J4-5 445 72 15.60 1.56 70 200,300 28 J6-6 445 72 15.60 1.56 70 110,200 28 J0-5 445 72 15.60 1.56 70 72,600 19 J10-5 445 72 15.60 1.56 70 72,600 19 J10-5 445 72 14.48 1.45 65 1,202,100 7 J10-7 445 72 14.48 1.45 65 1,005,800 4 J10-7 445 72 14.48 1.45 65 1,475,500 8 J10-7 445 72 14.48 1.45 65 1,475,500 8 J10-7 445 72 14.48 1.45	J9-6	±45	72	7.	•	80	•	6		
14-5 ±45 72 15.60 1.56 70 200,300 8 36-6 ±45 72 15.60 1.56 70 130,200 24 38-5 ±45 72 15.60 1.56 70 153,800 20 310-5 ±45 72 15.60 1.56 70 188,800 12 312-5 ±45 72 14.48 1.45 65 1,202,100 7 38-7 ±45 72 14.48 1.45 65 883,600 3 38-7 ±45 72 14.48 1.45 65 1,405,800 4 312-7 ±45 72 14.48 1.45 65 1,475,500 8 312-7 ±45 12.48 1.45 65 1,475,500 8 34-1 ±45 26 140 5,000,000+ 9	1	±4 5	72	7.8	•	80	١ ٧	6	1	
14-5 ±45 72 15.60 1.56 70 200,300 8 J6-6 ±45 72 15.60 1.56 70 110,200 24 J8-5 ±45 72 15.60 1.56 70 153,800 20 J10-5 ±45 72 15.60 1.56 70 188,800 12 J12-5 ±45 72 14.48 1.45 65 1,202,100 7 J8-7 ±45 72 14.48 1.45 65 1,202,100 7 J8-7 ±45 72 14.48 1.45 65 1,202,100 7 J12-7 ±45 72 14.48 1.45 65 1,475,500 8 J12-7 ±45 72 14.48 1.45 65 1,475,500 8 J4-1 ±45 260 14.0 85				•						
J6-6 445 72 15.60 1.56 70 110,200 24 J8-5 445 72 15.60 1.56 70 153,800 20 J10-5 445 72 15.60 1.56 70 72,600 19 J12-5 445 72 14.48 1.45 65 1,202,100 7 J10-7 445 72 14.48 1.45 65 1,005,800 4 J10-7 445 72 14.48 1.45 65 1,475,500 8 J12-7 445 72 14.48 1.45 65 1,475,500 8 J12-7 445 72 14.48 1.45 65 1,475,500 8 J4-1 445 1.24 60 5,000,000+ 9 20.07 test terminate J6-5 445 260 14.02 1.40	14-5	±45	72	15.60		7.0	200,300	ස	1	
38-5 445 72 15.60 1.56 70 72,600 20 310-5 445 72 15.60 1.56 70 72,600 19 312-5 445 1.56 70 188,800 12 77-5 445 1.45 65 1,202,100 7 310-7 445 1.45 65 1,202,100 7 310-7 445 1.45 65 1,005,800 4 310-7 445 1.45 65 1,475,500 8 312-7 445 1.45 65 1,475,500 8 312-7 445 1.45 65 1,475,500 8 312-4 45 12 14.0 85 42,200 5 31-1 45 260 14.02 1.40 85 42,200 5 <	J6-6	145	72	15.60	•	7.0	110,200	24		
J10-5 ±45 72 15.60 1.56 70 72,600 19 J12-5 ±45 72 15.60 1.56 70 188,900 12 J12-5 ±45 72 14.48 1.45 65 1,202,100 7 J8-7 ±45 72 14.48 1.45 65 1,005,800 4 J10-7 ±45 72 14.48 1.45 65 1,005,800 4 J12-7 ±45 72 14.48 1.45 65 1,475,500 8 J4-1 ±45 72 14.48 1.45 65 1,475,500 8 J4-1 ±45 260 14.02 1.40 85 42,200 5 J6-1 ±45 260 14.02 1.40 85 17,300 24 J12-1 ±45 260 14.02 1.40	J8-5	±45	72	5	٠	7.0	53	20	1	
J12-5 445 72 15.60 1.56 70 188,900 12 J7-5 445 72 14.48 1.45 65 1,202,100 7 J8-7 445 72 14.48 1.45 65 1,005,800 4 J10-7 445 72 14.48 1.45 65 1,005,800 4 J12-7 445 72 14.48 1.45 65 1,475,500 8 J4-1 445 72 14.02 1.40 85 43,400 18 J4-1 445 260 14.02 1.40 85 42,200 5 J9-1 445 260 14.02 1.40 85 17,700 11 J12-1 445 260 14.02 1.40 85 12,000 8 J12-1 445 260 14.02 1.40	6	145	72	5	٠.	70	72,600	19	ì	
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Jan 1.45 65 1,202,100 7 Jan 445 72 14.48 1.45 65 83,600 8 J10-7 445 72 14.48 1.45 65 1,005,800 4 J12-7 445 72 14.48 1.45 65 1,475,500 8 J12-7 445 72 14.48 1.45 65 1,475,500 8 J4-1 445 260 14.02 1.40 85 43,400 18 J6-5 445 260 14.02 1.40 85 42,200 5 J10-1 445 260 14.02 1.40 85 17,300 24 J12-1 445 260 14.02 1.40 85 12,000 8										
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7 ±45 72 14.48 1.45 65 1,005,800 4 7 ±45 72 14.48 1.45 65 1,475,500 8 45 72 13.37 1.34 60 5,000,000+ 9 20.07 test terminate 45 260 14.02 1.40 85 42,200 5 1 ±45 260 14.02 1.40 85 17,700 11 1 ±45 260 14.02 1.40 85 17,300 24 1 ±45 260 14.02 1.40 85 12,000 8 1 ±45 260 14.02 1.40 85 12,000 8 1 ±45 260 14.02 1.40 85 12,000 8	18-7	±45	72		•	59	3	က		
7 ±45 72 14.48 1.45 65 1,475,500 8 445 72 13.37 1.34 60 5,000,000+ 9 20.07 test terminate 445 260 14.02 1.40 85 42,200 5 1 ±45 260 14.02 1.40 85 17,700 11 1 ±45 260 14.02 1.40 85 17,700 8 1 ±45 260 14.02 1.40 85 12,000 8 1 ±45 260 14.02 1.40 85 12,000 8	310-7	±45	72		٠	65	,005	4	1	
4 ±45 72 13.37 1.34 60 5,000,000+ 9 20.07 test terminate 1 ±45 260 14.02 1.40 85 42,200 5 1 ±45 260 14.02 1.40 85 17,700 11 1 ±45 260 14.02 1.40 85 17,700 81 ±45 260 14.02 1.40 85 17,300 241 ±45 260 14.02 1.40 85 12,000 8	J12-7	145	72) ·	٠.	65	,475	8	1	
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5 ±45 260 14.02 1.40 85 42,200 5 1 ±45 260 14.02 1.40 85 17,700 11 -1 ±45 260 14.02 1.40 85 12,000 8 -1 ±45 260 14.02 1.40 85 12,000 8	J4-1	+45	260	14.02	•	85	43,400	1.8		
1 ±45 260 14.02 1.40 85 17,700 111 ±45 260 14.02 1.40 85 17,000 81 ±45 260 14.02 1.40 85 12,000 8	36-5	±45	260	T.	•	85	42,200	5	1	
-1 ±45 260 14.02 1.40 85 17,300 24 1 ±45 260 14.02 1.40 85 12,000 8	J8-1	±45	260	4	•	85	17,700		1	
-1 ±45 260 14.02 1.40 85 12,000 8	1	#45	260	4	•	8.5	17,300		1	
		4	260		•	85	2	8	1	

### HyE 1076J Fiber Test ction	1100	1	1	Patione	***************************************					R = +0.1
Piber Test Hox. Hin. Hox. Cycles Temp. Residual Lidasis Extraoption -45 260 13.19 1.32 80 133.800 10 ±45 260 13.19 1.32 80 133.800 10 ±45 260 13.19 1.32 80 106.500 10 ±45 260 13.19 1.32 80 60.500 10 ±45 260 13.19 1.32 80 60.500 10 ±45 260 12.37 1.24 75 924,300 7 ±45 260 12.37 1.24 75 159,400 7 ±45 260 12.37 1.24 75 513,200 7 ±45 260 12.37 1.24 75 513,200 7 ±45 260 12.37	Mater	AL, HYE	1							8
Piber Tree Name Probes Tree Name										- 1
Official Langer (197) (103 pair) (104 pair)		Piber	Test	Max.	Min.	Max.	Cycles	Temp.	Residual Strength	
4 ±45 260 13.19 1.32 80 83,800 10 5 ±45 260 13.19 1.32 80 133,800 14 5 ±45 260 13.19 1.32 80 25,700 26 6 ±45 260 13.19 1.32 80 60,500 10 6 ±45 260 13.19 1.32 80 60,500 10 7 ±45 260 12.37 1.24 75 924,300 7 6 ±45 260 12.37 1.24 75 935,200 7 6 ±45 260 12.37 1.24 75 935,400 7 6 ±45 260 12.37 1.24 75 935,400 7 10 ±45 260 12.37 1.24 75 935,00 4 1	Specimen	Orienta- tion	remp.	(10 ³ pat)	(10 pst)	(t ult.)	Failure	(a.)	(103 ps1)	Remarks
5 #45 260 13.19 1.32 80 133,800 14	J3-4	-45	260	13.19	1.32	80	φ	10	- 1	
7 #45 260 13.19 1.32 80 106,500 10 5 #45 260 13.19 1.32 80 25,700 26 6 #45 260 13.19 1.24 75 924,300 5 6 #45 260 12.37 1.24 75 924,300 5 6 #45 260 12.37 1.24 75 935,200 7 6 #45 260 12.37 1.24 75 935,200 7 7 #45 260 12.37 1.24 75 158,400 7 -6 #45 260 12.37 1.24 75 158,000 46 -3 0/#45/90 72 105.14 10.51 90 8,900 42 -3 0/#45/90 72 105.14 10.51 90	75-5	±45	260	-	٠.	80	133,800	14	1	
5 #45 260 13.19 1.32 80 25,700 26	37-7	±45	260	3.1	•	80	106,500	10		
6 ±45 260 13.19 1.32 80 60,500 10 6 ±45 260 12.37 1.24 75 924,300 5 6 ±45 260 12.37 1.24 75 935,200 7 6 ±45 260 12.37 1.24 75 935,200 7 6 ±45 260 12.37 1.24 75 935,200 7 6 ±45 260 12.37 1.24 75 937,800 7 -6 ±45 260 12.37 1.24 75 937,800 7 -7 0/±45/90 72 105.14 10.51 90 8,900 46 -3 0/±45/90 72 105.14 10.51 90 28,500 36 -3 0/±45/90 72 102.22 10.22 87.5 </td <td>1 1</td> <td>±45</td> <td>260</td> <td>3.1</td> <td>33</td> <td>80</td> <td>25,700</td> <td>56</td> <td></td> <td></td>	1 1	±45	260	3.1	33	80	25,700	56		
445 260 12.37 1.24 75 924,300 5 6 445 260 12.37 1.24 75 935,200 7 6 445 260 12.37 1.24 75 513,200 7 6 445 260 12.37 1.24 75 513,200 7 6 445 260 12.37 1.24 75 513,200 7 6 445 260 12.37 1.24 75 397,800 6 13 0/445/90 72 105.14 10.51 90 8,900 42 13 0/445/90 72 105.14 10.51 90 285,000 38 13 0/445/90 72 105.14 10.51 90 285,000 36 13 0/445/90 72 10.22 10.22 87.5		±45	260	3.1	٣.	80	60,500	10	1	
445 260 12.37 1.24 75 936,200 7 6 445 260 12.37 1.24 75 935,200 7 6 445 260 12.37 1.24 75 513,200 7 6 445 260 12.37 1.24 75 513,200 7 6 445 260 12.37 1.24 75 513,200 7 7 445/90 72 105.14 10.51 90 8,900 42 13 0/445/90 72 105.14 10.51 90 2,400 30 13 0/445/90 72 105.14 10.51 90 285,000 38 13 0/445/90 72 102.22 10.22 87.5 575,800 25 24 0/445/90 72 102.22 10.22 87.5										
7 ±45 260 12.37 1.24 75 935,200 7 6 ±45 260 12.37 1.24 75 158,400 7 6 ±45 260 12.37 1.24 75 513,200 7 6 ±45 260 12.37 1.24 75 513,200 7 10 ±45 260 12.37 1.24 75 397,800 6 13 0/±45/90 72 105.14 10.51 90 86,900 42 13 0/±45/90 72 105.14 10.51 90 88,900 42 13 0/±45/90 72 105.14 10.51 90 285,000 30 13 0/±45/90 72 105.22 10.22 87.5 80.5 25,300 35 13 0/±45/90 72 102.22	14-6	±45	260	2	2		24,	5	1	
6	7-92	±45	260		١.	7.5	35,	7	1	
-6 ±45 260 12.37 1.24 75 513,200 7 -6 ±45 260 12.37 1.24 75 397,800 6 -3 0/±45/90 72 105.14 10.51 90 4,800 46 -3 0/±45/90 72 105.14 10.51 90 8,900 42 -3 0/±45/90 72 105.14 10.51 90 88,200 65 -3 0/±45/90 72 105.14 10.51 90 285,000 38 -3 0/±45/90 72 102.22 10.22 87.5 87.5 875,800 39 -3 0/±45/90 72 102.22 10.22 87.5 417,300 36 -3 0/±45/90 72 102.22 10.22 87.5 417,300 36 -3 0/±45/90 72 <td>38-6</td> <td>145</td> <td>260</td> <td>2.3</td> <td>•</td> <td>75</td> <td></td> <td>7</td> <td>1</td> <td>de manuel mente de la companya de l</td>	38-6	145	260	2.3	•	75		7	1	de manuel mente de la companya de l
-6	110-6	±45	260	2.3	2.		13,	7	- 1	
-3 0/±45/90 72 105.14 10.51 90 4,800 46 -3 0/±45/90 72 105.14 10.51 90 88,200 42 -3 0/±45/90 72 105.14 10.51 90 2,400 30 -3 0/±45/90 72 105.14 10.51 90 285,000 38 -3 0/±45/90 72 105.14 10.51 90 285,000 38 -3 0/±45/90 72 102.22 10.22 87.5 25,300 25 -4 0/±45/90 72 102.22 10.22 87.5 575,800 25 -3 0/±45/90 72 102.22 10.22 87.5 575,800 36 -3 0/±45/90 72 102.22 10.22 87.5 575,800 36 -3 0/±45/90 72 99.30 9.93 85 580,800 46 -3 0/±45/90 72 99.30 9.93 85 546,200 32 -3 0/±45/90 72 99.30 9.93 85 546,200 32 -3 0/±45/90 72 99.30 9.93 85 546,200 32 -3 0/±45/90 72 99.30 9.93 85 546,200 32 -3 0/±45/90 72 99.30 9.93 85 546,200 32 -3 0/±45/90 72 99.30 9.93 85 546,200 32 -3 0/±45/90 72 99.30 9.93 85 546,200 32 -3 0/±45/90 72 99.30 9.93 85 546,200 32 -3 0/±45/90 72 99.30 9.93 85 546,200 32 -3 0/±45/90 72 99.30 9.93 85 546,200 32 -3 0/±45/90 72 99.30 9.93 85 546,200 32 -3 0/±45/90 72 99.30 9.93 85 546,200 32	J12-6	±45	260	ω.	.2		97,	9		
3 $0/\pm45/90$ 72 105.14 10.51 90 4.800 46 -2 $0/\pm45/90$ 72 105.14 10.51 90 $8,900$ 42 -3 $0/\pm45/90$ 72 105.14 10.51 90 2.400 30 -7 $0/\pm45/90$ 72 105.14 10.51 90 2.400 30 -3 $0/\pm45/90$ 72 105.14 10.51 90 $2.85,000$ 38 -3 $0/\pm45/90$ 72 102.22 10.22 87.5 87.5 80 -4 $0/\pm45/90$ 72 102.22 10.22 87.5 87.5 87.5 87.5 -5 $0/\pm45/90$ 72 102.22 10.22 87.5 87.5 $87.6,200$ 3.5 -3 $0/\pm45/90$ 72 99.30 9.93 85 $5.46,200$ 3.2 -3 $0/\pm45/90$ 72 99.30 9.93										
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	1 1	/*45/9	7	\ ~;	0	90	1 1	46		
-3 0/±45/90 72 105.14 10.51 90 88,200 65 -7 0/±45/90 72 105.14 10.51 90 2.400 30 -3 0/±45/90 72 105.14 10.51 90 285,000 38 -4 0/±45/90 72 102.22 10.22 87.5 25,300 25 -5 0/±45/90 72 102.22 10.22 87.5 25,300 35 -6 0/±45/90 72 102.22 10.22 87.5 417,300 36 -7 0/±45/90 72 102.22 10.22 87.5 417,300 36 -7 0/±45/90 72 99.30 9.93 85 6,349,300 23 -7 0/±45/90 72 99.30 9.93 85 6,349,300 33 -7 0/±45/90 72 99.30 9.93 85 85 846,200 42 -7 0/±45/90 72 99.30 9.93 85 85 846,200 32 -7 0/±45/90 72 99.30 9.93 85 85 846,200 32 -7 0/±45/90 72 99.30 9.93 85 85 846,200 32 -7 0/±45/90 72 99.30 9.93 85 85 8777,000 32 -7 0/±45/90 72 99.30 9.93 85 85 85 8777,000 32	317-2	/=45/		7	6	06		42	-1	телен тара жана жана жана жана жана жана жана ж
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	1	0/145/90		l T		06	8,	65] 	
-3 0/±45/90' 72 105.14 10.51 900 285,000 38 -3 0/±45/90' 72 102.22 10.22 87.5 575,800 25 -4 0/±45/90' 72 102.22 10.22 87.5 417,300 36 -2 0/±45/90' 72 102.22 10.22 87.5 417,300 36 -3 0/±45/90' 72 99.30 9.93 85 580,800 46 -3 0/±45/90' 72 99.30 9.93 85 546,200 42 -3 0/±45/90' 72 99.30 9.93 85 546,200 33 -3 0/±45/90' 72 99.30 9.93 85 546,200 32 -3 0/±45/90' 72 99.30 9.93 85 3,077,000 32 -8 0/±45/90' 72 99.30 9.93 85 3,077,000 32	3-	,	<u> </u>	-:	٠.	06	•	30	1	
-3 0/±45/90' 72 102.22 10.22 87.5 25,300 39 -4 0/±45/90' 72 102.22 10.22 87.5 575,800 25 -2 0/±45/90' 72 102.22 10.22 87.5 417,300 36 -3 0/±45/90' 72 99.30 9.93 85 580,800 46 -3 0/±45/90' 72 99.30 9.93 85 6,349,300 23 -3 0/±45/90' 72 99.30 9.93 85 6,349,300 32 -3 0/±45/90' 72 99.30 9.93 85 546,200 42 -3 0/±45/90' 72 99.30 9.93 85 546,200 32 -8 0/±45/90' 72 99.30 9.93 85 3,077,000 32	5	5/9	-	7.	0	06	85,	38	1 1	
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$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	520-3	0/±45/90	7	7	0.2	7	ω,	39	- 1]	
-2 0/±45/90' 72 102.22 10.22 87.5 417,300 36 -3 0/±45/90' 72 99.30 9.93 85 580,800 46 -3 0/±45/90' 72 99.30 9.93 85 6,349,300 23 -3 0/±45/90' 72 99.30 9.93 85 546,200 42 -3 0/±45/90' 72 99.30 9.93 85 3,077,000 32 -8 0/±45/90' 72 99.30 9.93 85 12,400 39	J22-4	0/445/90		. 2	0		75,	25	1	er en en de
-3 0/±45/90' 72 99.30 9.93 85 580,800 46 -3 0/±45/90' 72 99.30 9.93 85 6,349,300 23 -3 0/±45/90' 72 99.30 9.93 85 546,200 42 -3 0/±45/90' 72 99.30 9.93 85 3,077,000 32 -8 0/±45/90' 72 99.30 9.93 85 12,400 39	24-	5	7	02.2	0.2	7.	17,3	36		
-3 0/±45/90 72 99.30 9.93 85 580,800 46 -3 0/±45/90 72 99.30 9.93 85 6,349,300 23 -3 0/±45/90 72 99.30 9.93 85 546,200 42 -3 0/±45/90 72 99.30 9.93 85 3,077,000 32 -8 0/±45/90 72 99.30 9.93 85 3,077,000 39										end ender en entre de un des des en en estados en entre en entre en entre en entre en entre entre entre entre e
-3 $0/\pm45/90$ 72 99.30 9.93 85 6,349,300 23 -3 $0/\pm45/90$ 72 99.30 9.93 85 546,200 42 -3 $0/\pm45/90$ 72 99.30 9.93 85 3,077,000 32 -8 $0/\pm45/90$ 72 99.30 9.93 85 12,400 39	J13-3	0/145/90	72		١.	85	580,800	46		
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	J15-3			6	6	85	,349,	23	1	a produce a series de la colonia de la c
-3 0/±45/90 72 99.30 9.93 85 8,077,000 32 -8 0/±45/90 72 99.30 9.93 85 12,400 39	J17-3	0/145/90	72	99.30	6.	85		42	1 1 7	
-8 D/±45/90 72 99.30 9.93 85 12,400 39	J22-3			99.30	•	85	3,077,000	32		and the second s
	1 1	D/#45/90	72	99.30	6.	85	2,	39	1	an grann selection existence of the description of standard states, and standard states of the selection of the

'(0, +45, -45, 0, 0, -45, +45, 0 90, 0)s -20 ply

R = +0.1	Prequency # .30 Hz	Punction: 9ina	Remarks																				Para Para
A CONTRACTOR OF THE PROPERTY O			Residual Strength	1	118.31			the the real		1	-	640 May 480	***		1	70 17		h E 2	-				
			Temp. Rise (*F)	37	27	53	25	44	40	60	38	30	35	52	2.9	36	3.7	33	33				
			Cycles to Failure	628,800	+000,000,01	34,000	1,500	3,500	3,100	12,800	218,400	170,000	154,500	57,600	1,098,300	,808,	1,648,000	1,298,500	1,450,900				
			Max. Stress	80	80	96	06	90	90	80	80	80	80	80	7.5	75	7.5	7.5	7.5				
			Min. Stress	9.35		10.81	10.81	10.81	10.81	9.61	19.6	9.61	9.61	9.61	9.01		6	9.01	9.01				
Patigue			Stress	93.46	93.46	108.06	108.06	108.06	108.06	90.96	90.96	90.96	96,06	90.96	90.05	90.05	90.05	90.05	90.05				
Pensile F	10761		Test Temp.		7	260	260	260	260	260		260	260	260	260	_	260	260	260				
Tensile-Tensile	al: HVE		Fiber Orienta-	0/445/90	06/544/0	06/52#/0	06/57=/0	0/#45/90	06/577/0	06/54=/0	06/55#/0	0/145/00	0/445/90	p/*45/90	06/50=/0	0/*45/90	0/145/90	0/145/90	0/+45/90				
Test:	Material:		Specimen	٦.,		J15-6	J16-4	1 1	J23-6	314-4	16-5	320-5	-5		J14-5	J15-4	J20-4	J21-4	J24-3				

'(0, +45, -45, 0, 0, -45, +45, 0, 90, 0,)s -20 ply

1	112.7	1260							Prequency = 30 Hz
Materibi	# H72:	70/07	-						Sine
Specimen	Pilber Orienta-	Test Temp.	Max. Stress	Min. Stress (10 bel)	Max. Stress (% ult.)	Cycles to Failure	femp. Rise (°F)	Residual Strength (10 ³ psi)	Remarks
117-1	0/445/00	1	97.35	9.74	110	006		1	
		7	۳.	•	110	009	1 = 1	, . ,	
115-1	0/445/60	72	97.35	9.74	110	993,800	55	1	. The second
2 3 4 - 2	0/14/5/50	7	٣.		110	6,178,200	54		
,	3	-							
16-1	0/445/90	72	92.93	9.29	3.05	2,207,400	52	I I	
-0	1445/	7	2.9	2	105	1,100	6	1	
22-2	0/145/90	7.2	92.93	9.29	105	1,100	1		
4	/+45	7	2.9	.2	105	100	1	: :	
							The state of the s		
23-0	0/145/90	7.2	90.00	0.00	102	1,593,700	49	I I	
313-1	0/145/90	72	88.50	8.85	1.00	006			
5-	0/145/90	7	88.50	8.85	100	10,000,000+	46	118.35	
6	0/+45/90	7.2	88.50	8.85	100	1,483,760	34	1	s - manusphalus playblak - sekaskaspi Camp-ap-ap-andapi-kang-tapakhasaka - pamina massasak
	/ 445		8	ε.	001	620,900	4 .	1	
23-10	0/445	72	3.8	8.85	100	006	2		
-									райональная деренуля («пре-приямення» деленуля деленуля деленуля деленуля подрежения подрежения подрежения выс
314-1	0/145/90	72	84.08	8,41	95	10,000,000+	44	102.44	er de la companya de
			-,-						and the first of t
-									
		-			***************************************				

William Control

-20 ply (0, 445, -45, 0, 0, -45, +45, 0, 90, 0)_s

Stresses based 2 These specimens had a 0.1935 inth (0.491 cm) hole in center of test section. on net cross-sectional area.

Test:	Tensile-Tensile		Fatigue		-	The second secon		AND THE PROPERTY OF THE PROPER	***
Material:		1 1 1							Preduency # 30 8%
							- Carrie	Lasidna	L LAND L LYMBA CLAMB
	Fiher	Tert	Max.	Min.	Max.	Cycles	Rise.	Strength	; •
Specimen	Orienta-		(103 mei)	(10 ³ pst)	(1 ult.)	Failure	(*F)	(16 2 031)	Keta k K
1	+45°	72	14.05	1.41	85	009'9	8		
K9-4	±45°	72	14.05	1.41	85	11,200	25		
	+450	72	14.05	1.41	85	4,500	6		
T	+45°	72	14.05	1.41	85	2,300	6		e service and the service of the service and the service of the se
	+45°	72	14.05	1.41	85	2,700	8		
						-			
K10-5	+45°	72	12.40	1.24	75	35,400	4.1		
K10-4	+450	72	12.40	1.24	75	102,100	8		
K7-6	+450	72	12.40	1.24	75	142,700	7		
K6-3	+450	72	12.40	1.24	75	89,400	8		are the second of the second
K4-6	+45°	72	12.40	1.24	75	34,700	7		en e
K11-3	+45°	72	10.74	1.07	65	655,100	13		and and an experience of the second s
K11-2	±45°	72	10.74	1.07	65	840,300	15		
K8-2	+450	72	10.74	1.07	65	623,100	56		A PARTIE AND THE PROPERTY OF T
7.5.1	0 Y V +	7.2	10.74	1,07	65	1,169,700	26		AND THE PROPERTY OF THE PROPER
*5-4	+450	72	16.74		65	479,200	3		
									programmente esta merita de la magneta d La magneta de la magneta d
K10-6	±45°	260	13.23	1.32	85	3,900	21		rest de desença e de server engagnes espératures que la companya de la desença per constituença esta de la comp
x9-7	+45	260	13.23	1.32	35	4,500	10		en en gelande se en
K8-4	+45°	260	13.23	1.32	85	1,300	8		en daken gerind dispersion en deservater in deservater deservater deservater deservater deservater deservater
V65	+45°	260	13.23	1.32	85	7,800	24		
K4-7	±45°	260	13.23	1.32	. 58	2,700	90		
									e de destante en estado de desta de la composição de la composição de la composição de la composição de la comp
								-	andre digitale enterinde de des répetatiques de mais se des partir mon mandre seminare de manuel de seminare d
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1116	Tensile-Tensile Fatique						R = +0.1
G-160/6535-1	- 1	***************************************			-		
Test Max. Temp. Stress		Min. Stress	Max. Stress	Cycles to Failure	Temp. Rise (*F)	Residual Strength	Remarks
10.89	-	1.09	70	302,000	3		
260 10.89		1.09	70	35,200	2		Andreas de la companya de la company
260 10.89		1.09	70	85,700	7		ленде жана такан так
260 10.89	,	1.09	70	52,300	4		
260 10.89		1.09	70	108,900	19		
	}						
260 8.56 (- 1	0.86	55	2,092,400	0		
260 8.56 (ا	98.0	55	3,313,500	2		
260 8.56 (٦	0.86	55	3,014,200	2		
8.56	0	98.	55	6,265,800	2		
260 8.56 0		.86	55	4,881,600	0	***************************************	
72 77.79 7.	7.	.78	85	1,400	9		
72 77.79 7.		.78	85	30,600	28		
72 77.79 7.		.78	85	6,700	19		
7 67.77		. 78	85	200	7		
72 77.79 7.		78	85	300	0		entre de la companya
	_						
72 73.22 7		7.32	80	T3T,600	707		
72 73.22 7	7	.32	80	10,600	26		A PROPERTY OF THE PROPERTY AND THE PROPERTY OF
72 73.22 7	-	.32	80	10,000,000+	13		
7		.32	90	175,000	6		A SERVICE AND ADMINISTRATION OF THE PROPERTY O
72 73.22 7		7.32	80	3,900	27		
The second secon							

1(0,90,+45,-45,0,0,-45,+45,0,0)s-20 ply.

Fiber Hax. Hin. Hax. Cycles orienta Test Rices Stress Stress <th></th> <th>5</th>		5
Piber ton; Taber ton; Hax. Hin. Hax. Cycles n Orienta Taber ton Stress Stress Stress Lto 0/45/90¹ 72 68.64 6.86 75 1,094,400 0/45/90¹ 72 68.64 6.86 75 1,500 0/45/90¹ 72 68.64 6.86 75 1,500 0/45/90¹ 72 68.64 6.86 75 1,500 0/45/90¹ 72 68.64 6.86 75 1,500 0/45/90² 72 68.64 6.86 75 1,500 0/45/90² 72 86.34 8.63 95 400 0/45/90² 72 86.34 8.63 95 4,600 0/45/90² 72 86.34 8.63 95 4,600 0/45/90² 72 86.34 8.63 95 4,600 0/45/90² 72 81.79 8.18 90 217,300 0/45/		rreguency = 30 ms
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tion (**P) (10³ bg1) (10³ bg1) (10 bg1)	Temp. Residual	•
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0/45/90² 72 81.79 8.18 90 0/45/90² 72 81.79 8.18 90 0/45/90² 72 77.25 7.73 85 0/45/90² 72 77.25 7.73 85 0/45/90² 72 77.25 7.73 85 0/45/90² 72 77.25 7.73 85 0/45/90² 72 77.25 7.73 85 0/45/90² 72 77.25 7.73 85	24	
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$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	39	
0/45/90² 72 77.25 7.73 85 0/45/90² 72 77.25 7.73 85 2 0/45/90² 72 77.25 7.73 85 85 0/45/90² 72 77.25 7.73 85 0/45/90² 72 77.25 7.73 85		
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	25	
$0/45/90^2$ 72 77.25 7.73 85 $0/45/90^2$ 72 77.25 7.73 85 $0/45/90^2$ 72 77.25 7.73 85	15	
0/45/90 ² 72 77.25 7.73 85 0/45/90 ² 72 77.25 7.73 85	13	
0/45/90 ² 72 77.25 7.73 85	32	
	18	

R = +0.1	Frequency 4,30 Hz	Renerks																					The state of the s
		Residual Strength (10 ³ pai)																					
		Temp. Rise (*F)	27	1	11	25	10	26	27	22	22	1	18	10	18	## 	18						
		Cycles to Failure	13,500	200	006	2,600	500	8,656,400	10,500	6,900	30,500	300	1,790,000	1,500	5,600	4,585,200	2,700						
		Max. Stress (% ult.)	96	06	90	90	90	85	85	85	85	85	80	80	80	80	80						Prairie dispusi valent dispusivation
		Stress (10 yel)	8.76	8.76	8.76	8.76	8.76	8.27	8.27	8.27	8.27	B.27	7.78	7.78	7.78	7.78	7.78						
Fatigue		Max. Stress	87.55	87.55	87.55	87.55	87.55	82.69	82.69	82.69	82.69	82.69	77.82	77.82	77.82	77.82	77.82						
	G-160/6535-1	Test Temp. (*F)	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72						
Tensile-Tensile		Fiber Orienta- tlon	0/±453	0/±453	0/±453	0/±45³	0/±453	0/±453	0/+453	0/±45³	0/+453	0/±453	0/±453	0/±453	0/±453	0/±453	0/±453						
Test:	Materials	Specimen	K34-2	K34-6	K35-5	K35-9	K36-5	K36-7	K34-5	K35-3	K35-8	K36-2	X34-4	K34-8	K35-7	K36-1	K36-8	-				 Tradesian consense an area of a con-	:

3(0,45,-45,0,0,-45,45,0)s-16 ply.

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APPENDIX J CREEP AND STRESS RUPTURE DATA

All of the tensile creep data generated during this program, along with residual strengths of specimens which "ran out" to 500 hours are presented in this section. The residual strengths were all determined with a 72°F (22°C) tensile test regardless of what temperature the specimen saw during the creep test.

The stress rupture data were also obtained from these same specimens with the characteristic of interest being time to fracture rather than elongation.

Summaries of these data are presented in Sections 4.1 through 4.6 in both tabular and graphical form.

In the succeeding tables the specimen numbering system can be used to identify the material being tested. The letter, appearing first, in the specimen numbering code indicates the material, as follows:

F - T300/AFR800

G - Sic/5506

H - HyE 2034D

I - T300/V378A

J - HyE 1076J

K - G-160/6535-1

Test	Creep		Test	st: Creep			Test: Creep		
1						-			
Orient			i	. 0°		1 1	t: 0°	<u> </u>	
Spec. I	io: F1-13		1	No: <u>F3-8</u>		Spec.	Spec. No: F3-10		
Temp:	72°F{22°	<u> </u>	Temp: 72*F(22*C)			Temp	72*F(22*0	22	
Stress	: 163.8 ks	i 928 uit.	Stress:	163.8 15	92 % ult.	Stress	163.8 ksi	921 ult.	
Elap.	Accum.		Elap.	Accum.		Elap.	Accum.		
Time	Strain	Remarks	Time	Strain	Remarks	Time	Strain	Remarks	
(brs.)	(µ in/in)		(hrs.)	(#in/in)		(hrs.)	(µin/in)		
0	7872		0	8073		0	missed in	tial reading	
0.10	7884		6.017	8076		0.017	8037		
0.25	7913		0.10	8085		0.10	8044		
0.50	7908		0.33	8089		0.25	8048		
1	7919		0.50	8090		0.50	8050		
2	7916		1	8092		1	8058		
3	7917		2	8092		2	8058		
4	7920		3	8092		4	8059		
_5	7919		5	8092		88	8061		
δ	7916		- 6	8089		24	8084		
6.5	7917		. 7	8086		144	8117		
24	7934		8	8808		483	8114		
168	7974		24	8106		531	8064		
504	7992		72	8130					
			144	8122					
			217	8108					
			317	8092		 	<u> </u>		
			504	090		 			
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			<u></u>			<u> </u>	L		
	Recover			Recovery			Recovery		
0	102	Load off	0	13	Load off	0	42	Load off	
		 	1	3-		 		 	
 		f		-10			 	 	
	<u></u>	L	·	<u> </u>	L	l I	1	<u> </u>	

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Test:	Creep		Test:	Creep		Test:	Creep	
Orient	. 0•		1	: 00	-		t: 0*	
}	To: F4-1		į	No: F4-15				
			1				No: <u>F5-2</u>	
Temp:	72°F(22	<u>-c)</u>	Temp:	: 72°F (22°C)		Temp	72°F(2	(2°C)
Stress	: 143.4 kg	180 t ult.	Stress	Stress: 143.4 ksi 80 % ult.			<u> 143.4</u> ksi	80 t Wit.
Elap.	Accum.	· · · · · · · · · · · · · · · · · · ·			Elap. Accum.			
Time	Strain	Remarks	Time	Strain	Remarks	Time		Remarks
(hrs.)				(Fin/in)		(hrs.)		
0	6618		0	6770		0	6563	
0.017	6818		0.017	6772		0.017	6563	
0.10	6818		0.10	6768		0.10	6562	
0.25	6817		0-25	5769		0,25	6562	
0.50	6816		0.50	5770		0.50	6560	
1	6816		1	6764		1	6562	
2	6813		2	6763		2	6559	
3.1	6806		_3.1	5759		3.1	6552	
4	6803		4	6754		4	6548	
5	6807		5	6764		5	6556	
6	6815		6	6765		6	6556	
7	6813		7	6764		7	6557	
24	6824		24	6776		24	6570	
96	6900		96	6790		96	6588	
120	6900		120	6804		120	6600	
190	6864		190	6822		190	6618	
263	6840		263	6802		263	6610	
336	6830		336	6788		336	6588	
435	6818		435	6780		435	6576	
504	6812		504	6770		504	6569	
			<u> </u>					
					<u> </u>			
	Recover	,		Recovery	·		Recovery	
0	-13	Load off	0	-15	Load off	<u> </u>	-26	Load off
 -	0	3		- 1		1	-12	
3	0		3	- 6		3	-13	
L	L	L	l	L	L		<u> </u>	<u> </u>

Test: Creep	Test: Creep	Test: Creep
V - 1 C+12.	Orient.	Orient: 0*
Spec. No: F1-15	Spec. No: F3-2	Spec. No: F4-12
Temp: 260°F(127°C)	Temp: 260°F(127°C)	Temp: 260°F(127°C)
Stress: 174.5 ksi 90 % ult.	Stress: 174.5 hsi 90 % ult.	Stress 174.5 kgi 90 % ult.
Elap. Accum.	Elap. Accum.	Elap. Accum.
Time Strain Remarks	Time Strain Remarks	Time Strain Remarks
(hrs.) (µ in/in) 0 8361	(hrs.) (Pin/in)	(hrs.) (µin/in)
0 8361 failed before 0.017 hr.	0.017 8363	0 8531
Tailed Delote G.OL7 hr.		0.017 8531
	failed before 0.1 hr.	0.10 8531
		0.25 8531 0.50 8531
		1 8532
		2 8532
		3 8537
		4 8525
		6 8529
		24 8554
		51.5 8604
		79 8680
		310 9726
		486 gage failed
		500+
		specimen did not fail
		-
Recovery	Recovery	Recovery
		4
		
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Test:	Creep		Test: Creep			Test: Creep		
_						Orient		
1	: 0° Vo: Fl-1	7		:: 0° No: F1-	12	1	No: F3-1	6
I					,			
Temp:	260°F(127°C)		260°F(·	Temp:	260°F(12	7°C)
Stress	: 155.1 ks	1 80 8 ult.		155.1 ks:	80 % ult.	Stress	155.1 ks:	80 t ult.
Elap.	Accum.		Elap.	Accum.		Elap.	Accum.	
Time		Remarks	Time	Strain	Remarks	Time	Strain	Remarks
	(µin/in)		(hrs.)			(hrs.)	(µin/in)	foiled
0	7436		0	7574				gage failed
0.017	7442		0.017	7584		0.05	specime	n failed
0.10	7460		0.10	7600				
0.25	7474		0.25	7620				
0.50	7477		0.50	7633				
1	7475		11	7648				
2	7484		- 2	7672				
3	7481		3	7685				
5.3	7498		5	7700				
7.3	7490		7.2	77,1				
47.5	7508		47.5	7795				
148	7560		148	7901				
217	7577		217	7927				
366	7589		366	7970				
413	7597	,	413	7977				
480	. 7612		480	7986				
503	7601		503	8001				
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	L	<u> </u>		<u> </u>				
	Recover	У		Recovery			Recovery	
0	74	Load off	0	528	Load off			
1	16			480				
2	14		2	465				
L	<u> </u>			<u> </u>		J I	<u></u>	<u> </u>

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Test:	Test: Creep			Creep		Test: Creep				
Orient	. 0•		Orient	: <u>0•</u>		Orien	Orient: 0°			
Spec. N	Vo: <u>F1-5</u>		Spec.	No: F4-6		Spec.	No: F5-11			
Temp:	260 °F	(127°C)	Temp	Temp: 260°F(127°C) Temp: 260°F(127°C)				.27 °C)		
Stress	<u> 135.7 ks</u>	<u>i 70 € ult.</u>	Stress	135.7 ks	<u>70 % ult.</u>	Stresı	<u> 135.7</u> ksi	70 tult.		
Elap. Time (hrs.)	Accum. Strain (# in/in)	Remarks	Time	Accum. Strain (#in/in)	Remarks	Elap. Time (hrs.)	Accum. Strain (µin/in)	Remarks		
2	6648		0	6705	-	0	6767			
0.017	6659		0.017	6713		0.017	6775			
0.25	6661		0.25	6719		0.25	6777			
0.50	6664		0.50	6714		0.50	6776			
1	6664		1	6716		1	6,775			
4	6671		4	6723		4	6785			
5	6683		5	6725		5	6826			
6	6684		6	6721		6	6822			
7	6681		7	~6723		7_	6832			
8	6683		8	6723		8	6832			
24	6690		24	6731		24	6832			
72	6704		77	6735		27	6840			
271	6724		271	6712		271	6815			
344	6718		344	6720		344	6850			
434.5	6715		434.5	6709		434.5	6843			
480	6718		480	6714		480	6845			
580	6730		580	6727		380	6858			
						 				
						 				
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	Recover	ÿ		Recovery	and the second second		Recovery			
0	111	Load off	0	128	toad off		132	Load off		
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				AFR-6	300			
Test:_	Creep		Test:	Creep		Test:	Creep	
Orient	0°		Orient	0*		Orient	:: 0°	
Spec. N	io: F6-17		Spec.	No: F22-1		Spec.	No: F22-8	
Temp:	350°F(17	7°C)	Temp	350°F(17	7°C)	Temp	350°F(1	.77 °C)
Stress	: 156.2 ks	1 90 % ult.	Stress	Stress: 156.2 ksi 90 % ult.			_156.2 kg	90 t uit.
Elap. Time	Strain	Remarks	Time		Remarks	Elap. Time	Strain	Remarks
	(µ in/in)		(hrs.)	(#in/in)		(hrs.)	(µin/in)	
0	7673		0	8310		0	7981	
0.017	7670		0.017	8324		0.017	8009	
0.10	7654		0.10	8337		0.10	8014	
0.25	7659		0.25	8340		0.25	8010	
0.50	7669		0.50	8359		0.50	8067	
1	7672		1	8318		1	8078	
2	7687		2	8307		2	8086	
4	7706		4	8329		4	8091	
5	7718		5	8313		5	8092	
6	7729		6	8314		6	8092	
7	7740		7	8 306		7	8090	
24	7837		24	8280		24	8131	
72	7995		168	8221		72	8220	
168	8153		264	8221		168	8243	
264	8270		360	8216		264	8298	
336	8323		432	8256		336	8348	
433	8449		503	8271		433	8436	
504	8477					504	8469	
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	<u> </u>			<u></u>				
	Recover	y		Recovery			Recovery	
0	705	Load off	0	366	Load off	0	440	Load off
.1	655		1	306		1	355	
2	652		2	296		2	829	
3	642	<u> </u>	3	291	<u> </u>	3	312	

Test:	Creep		Test:	Creep		Test:	Creep	
Orient	: 0°		_	: 0°		_	: <u>0°</u>	
1	No: F5-10		1	No: F6-2		i	No: F6-6	
1 -	350°F(1		· -	350°F(1		_	350°F(1	.77°C)
1		i 80 % ult.	1	Stress: 138.8 kmi 80 % ult.			138.8 ksi	
Elap.	Accum.		Elap.	Accum.		Elap.	Accum.	
Time	Strain	Remarks	Time	Strain	Remarks	Time		Remarks
(hrs.)	(µ in/in)	:	(hrs.)	(Fin/in)		(hrs.)	(µin/in)	
0	6493		0	7163		0	6637	
0-017	6493	· ·	0.017	7175		0.017	6645	
0.10	6490		0.10	7181		0.10	6551	
0.25	6490		0.25	7190		0.25	6662	
0.50	6494		0.50	7196		0.50	6662	
1	6496		1.25	7180		1	6677	
2.5	6497		2	7203		2.5	6688	
3	6491		4	7209		3	6675	
4	6491		5	7209		4	6664	
5	6504		6	7216		5	6673	
6	6504		7	7216		-6	6678	
24	6503		24	7245		24	6677	
168	6508		72	7268		168	6694	
264	6519		173	7307		264	6678	
360	6553		264	7330		360	6713	
432	6553		336	7353		432	6726	
502	6572		433	7372		502	6742	
			503	7396				
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	Recover			Recovery			Recovery	
0	143	Load off	0	174	Load off	0	190 170	Load off
1	134	 	1 2	148	 	2		<u> </u>
3	125	 	2	145	 	3	157 152	
L_3	1 770	L	3	138	<u></u>		1 434	<u> </u>

Test:_	Creep		Test:			Test:		
Orient	: <u>0•</u>		Orient	:		Orien	<u> </u>	
Spec. 1	ło: <u>F6-11</u>		Spec.	No:		Spec. No:		
Temp:	350°F(1	77°C)				Temp	·	
Stress	Stress: 138.8 ksi 80 % ult.		Stress: kei_t ult.			Stores	issi	s ult.
Elap. Time	Accum. Strain	Remarks		Accum. Strain	Remarks	Elap. Time	Accum. Strain	Remarks
(hrs.)	(# in/in)		(brs.)	(Pin/in)		(hrs.)	(µin/in)	
0	7390							
0.017	7402		L					
0.10	7410							
0.25	7394			<u> </u>				
0.50	7403							
1.1	7412							
5	7439							
6	7462							
71	7493							
172	7493							
265	7502		-					
436	7542			 				
600	7542			 				<u> </u>
								
 			 			 		
				 			<u></u>	
			 				 	
				-				
				 				
				1				
					<u> </u>			
	Recover	y		Recovery			Recovery	,
0	297	Load off						
1	200							
3.5	188							
4	184				<u>L</u>]		

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Test: Creep				~						
Spec. No: F1-17 Temp: 350°F(177°C) Stress: 121.5 ksi 70 % ult. Elap. Accum. Time Strain (hrs.) (linfth) C C259 O.20 6349 O.75 6526 O.50 6365 O.50 6365 O.50 6365 O.50 63649 O.50 63649 O.50 63649 O.50 63649 O.50 6365 O.50 63649 O.50 63649 O.50 6365 O.50 O.50 6365 O.50 O.50 6365 O.50 O.										
Temp: 350°F(177°C) Stress: 121.5 ksi 70 % ult. Elap. Accum. Time Strain Remarks (hrs.) (µin/in) C 6259 O.05 6308 O.20 6349 O.550 6365 1 6358 2 6541 O.550 6365 2 6541 O.550 6365 3 6449 3 6449 5 6 6556 5 6479 24 6651 5 6479 24 6622 5 5 66479 6 6499 95 6726 144 6769 192 6794 144 6769 192 6794 144 6769 192 6794 106 6822 106 0807 1073 Load off 1 680 2 1362 1 1368 2 1362 1 1368 2 1362 1 1368 2 1362 1 1368 2 1362 1 1368 2 1362 1 1368 2 1362 1 1368 2 1362 1 1368 2 1362 1 1368 2 1355 1 1-138* 2 1-146				Orient	: <u>0*</u>		Orient	: 0,		
Stress: 121.5 ksi 70 % ult. Stre				1			Spec. 1	No: F5-4		
Elap. Accum. Time Strain Remarks (hrs.) (\(\beta\) in/in) C 6259 O.05 6308 O.20 6349 O.50 6365 1 6365 2 6541 3 6449 5 6558 3 6479 6 6499 9 95 6723 6 6 649 24 6651 144 6769 1360 6860 Recovery	Temp:	350°F(1	77 °C)	Temp	350°F()	177°C)	Temp	350°F(1	.77°C)	
Time Strain Remarks (hrs.) (\(\beta\) (h	Stress	: 121.5 ks	d 70 % ult.	Stress	121.5	i 70 % ult.	Stress_121.5 kg		70 t ult.	
(hrs.) (hr/in)	Elap.						Elap.	Accum.		
0 6259 0 missed zeating 0 5678 0.05 6308 0.75 6526 0.05 5672 0.20 6349 1 6535 0.20 5652 0.50 6365 2 6541 0.50 5652 1 5388 3 6651 1 5550 2 6429 4 6557 2 5640 3 6449 5 6558 3 5638 4 6467 6 6566 4 5638 5 6479 24 6622 5 5643 6 6499 95 6723 6 5648 24 6651 144 6762 24 5618 95 6726 192 6792 95 5582 144 6769 264 6812 144 590 192 6794 360 6847 192 588 301 6880 254 593 5545 503 6892			1 1	1		•	F =		?	
0.05 6308 0.75 6526 0.05 5672 0.20 6349 1 6535 0.20 5659 0.50 5655 1 5388 3 6551 1 5550 2 5640 3 6449 5 6558 3 5638 3 5638 4 6467 6 6566 4 5638 5 6479 24 6622 5 5643 6 6561 6 6566 6 6 6 6 6 6 6	(hrs.)	(µ in/in)		(hr =.)	(µin/in)		(hrs.)	(pin/in)		
0.20 6349 1 6535 0,20 5659 0.50 6365 1 5388 3 6551 1 5550 1 5550 1 5550 2 6429 4 6557 2 5640 3 5638 4 6467 6 6 6566 4 5638 5 6479 24 6622 5 5 5641 6 5649 6 6 6566 1 144 6762 24 5618 95 6723 6 6 5649 192 6792 95 5582 144 6769 192 6792 95 5582 144 6769 192 6792 95 5582 144 6769 192 6792 95 5582 1560 6822 432 6880 254 6822 432 6880 50 6847 192 5558 1503 6880 1503 688	0	6259		0	missed:	eading	0	5678		
0.50 6365 2 6541 0.50 5652 1 5388 3 6551 1 5650 2 5640 3 6449 5 6558 3 5638 4 6467 6 6566 4 5638 5 6479 24 6622 5 5648 3	0.05	6308		0.75	6526	<u> </u>	0.05	5672		
1 5388 3 6651 1 5550 2 5640 3 6557 2 5640 3 6449 5 6558 3 5638 4 6557 5 6566 4 5638 5 6479 2 4 6622 5 5 6441 5 6 6 6566 4 5631 5 6 6479 2 4 6651 144 6762 2 44 5618 5 6 656 6 6 647 192 6792 95 5580 144 6769 2 664 6812 144 5590 192 6794 192 6794 192 5582 264 6822 4 5618 192 6880 2 254 5558 5580 503 6880 5558 5580 503 6880 5558 5580 503 6880 5558 5580 503 5545 503 503 503 503 5545 503 503 503 503 503 503 503 503 503 50	0.20	6349		1	6535		0.20	5659		
2 6429 4 6557 2 5640 3 6449 5 6558 3 5638 4 6467 6 6566 4 5638 5 6479 24 6622 5 5643 6 6499 95 6723 6 5648 24 6651 144 6762 24 5618 95 6726 192 6792 95 5582 144 6769 264 6812 144 5990 192 6794 360 6847 192 5582 264 6822 432 6880 254 5573 360 C875 503 6892 360 5558 432 6880 503 5545 503 5545 503 6880 503 5545 503 5545 6 6880 503 5545 503 5545 7 753 Load off 1 1368 1 -138	0.50	6365		2	6541		0.50	5652		
3 6449 5 6558 3 5638 4 6467 6 6566 4 5638 5 6479 24 6622 5 5643 6 6499 95 6723 6 5648 24 6651 144 6762 24 5618 95 6726 192 6792 95 5582 144 6769 264 6812 144 5590 192 6794 360 6847 192 5582 264 6822 432 6880 254 5573 360 C875 503 6892 360 5558 432 6880 432 5554 503 5545 503 6880 503 5545 503 5545 503 6880 503 5545 503 5545 503 5545 503 5545 503 5545 6 6880 7 7 7 7 7	1	5388		3	6551		1	5650		
4 5467 6 6566 4 5638 5 6479 24 6622 5 3643 6 6499 95 6723 6 5648 24 6651 144 6762 24 5618 95 6726 192 6792 95 558° 144 6769 264 6812 144 5590 192 6794 360 6847 192 5582 264 6822 432 6880 254 5573 360 6875 503 6892 360 5558 432 6880 432 5554 503 6880 432 5554 503 5545 503 5545 503 5545 503 5545 503 5545 503 5545 Recovery 0 753 Load off 0 1402 Load off 0 -116 Load off 1 6890 1 1368 1 <td>2</td> <td>6429</td> <td></td> <td>4</td> <td>6557</td> <td></td> <td>2</td> <td>5640</td> <td></td>	2	6429		4	6557		2	5640		
5 6479 24 6622 5 5643 6 6499 95 6723 6 5648 24 6651 144 6762 24 5618 95 6726 192 6792 95 558° 144 6769 264 6812 144 5590 192 6794 360 6847 192 5582 264 6822 432 6880 254 5573 360 C8975 503 6892 360 \$558 432 6880 432 5554 5554 503 6880 432 5554 503 5545 503 5880 503 5545 503 5545 503 5545 503 5545 503 5545 680 753 6880 7545 7545 7545 7545 7 753 6880 7545 7545 7545 7545 7545 7545 7545 7545 7545 7545 75	3	6449		5	6558		3	5638		
6 6499 95 6723 6 5648 24 6651 144 6762 24 5618 95 6726 192 6792 95 558° 144 6769 264 6812 144 5590 192 6794 360 6847 192 5582 264 6822 432 6880 254 5573 360 6875 503 6892 360 5558 432 6880 432 5554 503 6880 503 5545 503 5545 503 5545 6880 503 5545 7 8200 820 820 880 880 83 83 880 880 83 83 880 880 83 83 880 880 83 83 880 880 83 83 880 83 83 83 880 83 83 <	4	6467		6	6566		4	5638		
24 6651 144 6762 24 5618 95 6726 192 6792 95 558° 144 6769 264 6812 144 5590 192 6794 360 6847 192 5582 264 6822 432 6880 254 5573 360 6875 503 6892 360 5558 432 6880 432 5554 503 6880 503 5545 503 5545 503 5545 503 5545 503 5545 880 880 880 880 880 880 880 880 880 880 880 880 880 880 880 880 880 880 880 880 880 880 880 880 880 880 880 880 880 880 880 880 880 880 880 880 880 880 880 880 880 880 880 880 880 880 880 880	5	6479		24	6622		5	5643		
95 6726 192 6792 95 558° 144 6769 192 6794 360 6847 192 5582 264 6822 432 6880 254 5573 360 6875 503 6892 360 5558 503 5585 503 5585 503 5545 503 50	6	6499		95	6723		- 6	5648		
144 6769 264 6812 144 5590 192 5582 264 6822 432 6880 254 5573 360 6875 503 6892 360 5558 432 6880 503 5545 503 5	24	6651		144	6762		24	5618		
192 6794 360 6847 192 5582	95	6726		192	6792		95	5589		
264 6822 432 6880 254 5573 360 5558 432 6880 503 6892 503 5554 503 5545	344	6769		264	6812		144	5590		
Solution	192	6794		360	6847		192	5582		
### Recovery Recovery Recovery 0 753 Load off 1 1368 1 -138 2 362 2 1355 2 -146	254	6822		432	6880		254	5573		
Solution	360	6875		503	6892		360	5558		
Recovery Racovery Recovery 0 753 Load off 0 1402 Load off 0 -116 Load off 1 680 1 1368 1 -138 2 -146	432	688C					432	5554		
0 753 Load off 0 1402 Load off 0 -116 Load off 1 680 1 1368 1 -138 1 -138 2 -146	503	6880					503	5545		
0 753 Load off 0 1402 Load off 0 -116 Load off 1 680 1 1368 1 -138 1 -138 2 -146										
0 753 Load off 0 1402 Load off 0 -116 Load off 1 680 1 1368 1 -138 1 -138 2 -146						<u> </u>	 			
0 753 Load off 0 1402 Load off 0 -116 Load off 1 680 1 1368 1 -138 1 -138 2 -146										
0 753 Load off 0 1402 Load off 0 -116 Load off 1 680 1 1368 1 -138 1 -138 2 -146						<u></u>				
0 753 Load off 0 1402 Load off 0 -116 Load off 1 680 1 1368 1 -138 1 -138 2 -146						 	↓ 			
0 753 Load off 0 1402 Load off 0 -116 Load off 1 680 1 1368 1 -138 1 -138 2 -146									ļ	
0 753 Load off 0 1402 Load off 0 -116 Load off 1 680 1 1368 1 -138 1 -138 2 -146						<u> </u>	 		<u> </u>	
0 753 Load off 0 1402 Load off 0 -116 Load off 1 680 1 1368 1 -138 1 -138 2 -146							 		ļ <u>.</u>	
0 753 Load off 0 1402 Load off 0 -116 Load off 1 680 1 1368 1 -138 1 -138 2 -146						<u> </u>	 			
0 753 Load off 0 1402 Load off 0 -116 Load off 1 680 1 1368 1 -138 1 -138 2 -146					<u> </u>	<u> </u>	 	<u></u>		
1 680 1 1368 1 -138 2 362 2 1355 2 -146		Recover	7		Racovery	·	 	Recovery		
2 362 2 1355 2 -146			Load off			Load off	•		Load off	
		 				 	1	1	 	
3 652 3 1353 3 -148						 	1	1		
	3	652	<u> </u>	3	1353] _3	-148	<u> </u>	

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Orient: 90°		Test: Creep		
	Orient: 90°	Orient: 90°		
Spec. No: F8-10	Spec. No: F11-3	Spec. No: F13-4		
Temp: 72°F(22°C)	Temp: 72°F(22°C)	Temp: 72°F(22°C)		
Stress: 3.21 ksi 70 t ult.	Stress: 3.21 ksi 70 % ult.	Stress 3.21 ksi 70 % ult.		
Elap. Accum. Time Strain Remarks	Elap. Accum. Time Strain Remarks	Elap. Accum. Time Strain Remarks		
(hrs.) (µin/in)	(hrs.) (µin/in)	(hrs.) (μin/in)		
0 failed on loading	0 failed on loading	0 failed on loading		
		 		
				
		 		
Recovery	Recovery	Recovery		
V. eco. et à	11100.427			

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Test: Cresp Orient: 90° Spec. No: F8-4 Temp: 72°F(22°C) Stress: 2.75 ksi 66 % ult. Elap. Accum. Time Strain Remarks (hrs.) (µ in/in) 0 saissed reading 0.017 1864 0.10 1879 0.25 1888 0.50 1893 1 1909 2 1918 6 1941 24 1965 1 196 296 1145 2068 1194 2095 1318 2147 482 2206 530.4 2191 Test: Cresp Orient: 90° Spec. No: F9-5 Temp: 72°F(22°C) Stress: 2.75 ksi 60 % ult. Elap. Accum. Time Strain Remarks (hrs.) (µin/in) Time Strain Remarks (hrs.) (µin/in) 0 missed reading 0 no.17 1893 0 no.10 1905 0 nissed reading 0 no.10 1903 Spec. No: F9-5 Temp: 72°F(22°C) Stress 2.75 ksi 60 % ult. Elap. Accum. Time Strain Remarks (hrs.) (µin/in) 10 nissed reading 0 no.17 1893 0.10 1903 0.10 1903 Spec. No: F9-5 Temp: 72°F(22°C) Stress 2.75 ksi 60 % ult. Elap. Accum. Time Strain Remarks (hrs.) (µin/in) 10 nissed reading 0 no.17 1893 0.10 1903 Spec. No: F9-5 Temp: 72°F(22°C) Stress 2.75 ksi 60 % ult. Elap. Accum. Time Strain Remarks (hrs.) (µin/in) 10 nissed reading 0 no.17 1893 0.10 1903 0.10 1903 Spec. No: F9-5 Temp: 72°F(22°C) Stress 2.75 ksi 60 % ult. Elap. Accum. Time Strain Remarks (hrs.) (µin/in) 10 nissed reading 0 no.17 1893 0.10 1903 0.10 1903 Spec. No: F9-5 Temp: 72°F(22°C) Stress 2.75 ksi 60 % ult. Elap. Accum. Time Strain Remarks (hrs.) (µin/in) 11 ne Strain Remarks (hrs.) (µin/in) 12 no.10 1903 1891 0.10 1903 0.10 1903 0.10 1903 0.10 1903 0.10 1903 0.10 1903 0.10 1903 0.10 1903 0.10 1903 0.10 1903 0.10 1903 0.10 1903 0.10 1903 0.10 1903 0.10 1903 0.10 1905 0.25 1919 0.25 1919 0.25 1919 0.25 1919 0.25 1919 0.25 1919 0.25 1919 0.25 1919 0.25 1919 0					APR-800				
Spec. No: F8-4 Spec. No: F9-3 Spec. No: F9-5 Temp: 72°F(22°C) Temp: 72°F(22°C) Temp: 72°F(22°C) Stress: 2.75 xsi 60° ult. Stress: 2.75 xsi 60° ult. Stress: 2.75 xsi 60° ult. Elap. Accurn. Time Strain (hrs.) (μin/in) Flap. Accurn. Time Strain (hrs.) (μin/in) (hrs.) (μin/in) 0 1891 0.017 1864 0.017 1893 0.10 1903 0.10 1879 0.10 1905 specimen failed 0.50 1893 0.50 1928 0.50 1 1909 1 1933 0.50 2 1918 2 1950 0.50 5 1937 5 1968 0.50 6 1943 2 1981 0.50 145 2068 145 2116 0.50 188 2147 316 2199 0.50 <t< td=""><td>Test:_</td><td>Creep</td><td></td><td>Test:</td><td>Creep</td><td></td><td>Test.</td><td>Creep</td><td></td></t<>	Test:_	Creep		Test:	Creep		Test.	Creep	
Temp: 72°F(22°C) Stress: 2.75 ksi 60 kult. Elsp. Accum. Time Strain Remarks (hrs.) (μ in/in) 0 missed reading 0 missed reading 0 l891 0.017 1864 0.017 1893 0.10 1903 0.10 1879 0.25 1888 0.50 1893 0.50 1928 1 1909 1 1 1933 2 1918 2 1950 5 1937 5 1968 8 1943 8 1981 24 1965 24 2002 145 2068 194 2142 318 2147 318 2199 482 2206 482 2261	Orient	90*		Orien	: 90°		Orien	it: 90°	
Strass: 2.75 ksi 60 % ult. Elap. Accum. Time Strain (hrs.) Elap. Accum. Time Strain (hrs.) Elap. Accum. Time Strain (hrs.) Remarks (hrs.) Elap. Accum. Time Strain (hrs.) Remarks (hrs.) Image: Ima	Spec. I	No: F8-4		Spec.	No: 179-		Spec.	No: F9-5	
Elap. Accum. Time Strain (μ in/in) O missed reading O.017 1864 O.10 1879 O.50 1893 O.50 1893 O.50 1893 O.50 1893 O.50 1928 I 1909 I 1933 I 1909 I 1933 I 1943 I 1965 I 194 2095 I 194 2142 I 194 2296 O missed reading Elap. Accum. Time Strain (hrs.) (μin/in) O missed reading O missed reading O 1891 O.10 1903 Speciman failed O.25 1919 O.50 1928 I 1933 I 1933 I 1943 I 1965 I 1965 I 1968 I 1970 I 1968 I 1970 I 1	Temp:	72°F(22	(*c)	Temp	72°F(2	2 °C)	Tem	2: 72°F(22	*C)
Time (hrs.) (μ in/in) O missed eading O.017 1864 O.10 1879 O.25 1888 O.50 1893 1 1909 1 1933 2 1918 2 1928 5 1968 6 1943 2 1965 1 1965 1 1965 1 194 2 206 1 194 2 2206 Time (hrs.) (μin/in) O missed reading O missed reading O 1891 O.10 1903 O.10 1903 Specimen failed O.50 1928 O.50	Stress	: 2.75 ks	11 60 % ult.	Stress	Stress: 2.75 Hsi 60 t ult.			S 2.75 15	60 tult.
(hrs.) (μ in/in)		-			•		, , -	*	
0 missed eading 0 missed reading 0 1891 0.017 1864 0.017 1893 0.10 1903 0.10 1879 0.10 1905 specimen failed 0.25 1888 0.25 1919] - 1	1 1	•				
0.017 1864 0.017 1893 0.10 1903 0.10 1879 0.10 1905 specimen failed 0.25 1888 0.25 1919 1909 1 1999 1 1933 1933 2 1918 2 1950 5 1937 5 1968 8 1943 8 1981 24 1965 24 2002 145 2068 145 2116 194 2095 194 2142 318 2147 318 2199 482 2266 482 2261									
0.10 1879 0.10 1905 specimen failed 0.25 1888 0.25 1919 0 0.50 1893 0.50 1928 0 1 1909 1 1 1933 0 2 1918 2 1950 0 5 1937 5 1968 0 8 1943 8 1981 0 24 1965 24 2002 0 145 2068 145 2116 0 194 2095 194 2142 0 318 2147 318 2199 0 482 2261 0			tearrid			reading	! 	_	
0.25 1888 0.25 1919 0.50 1893 0.50 1928 1 1909 1 1933 2 1918 2 1950 5 1937 5 1968 6 1943 8 1981 24 1965 24 2002 145 2068 145 2116 194 2095 194 2142 318 2147 318 2199 482 2266 482 2261			-			 	} }		<u> </u>
0.50 1893 0.50 1928 1 1 1909 1 1933 1 2 1918 2 1950 1 5 1937 5 1968 1 6 1943 8 1981 1 24 1965 24 2002 1 145 2068 145 2116 1 194 2095 194 2142 1 318 2147 318 2199 1 482 2261 482 2261 1	-		 		 			Procume tall	-
1 1909 1 1933 2 1918 2 1950 5 1937 5 1968 8 1943 8 1981 24 1965 24 2002 145 2068 145 2116 194 2095 194 2142 318 2147 318 2199 482 2266 482 2261			 			 		 	
2 1918 2 1950 5 1937 5 1968 8 1943 8 1981 24 1965 24 2002 145 2068 145 2116 194 2095 194 2142 318 2147 318 2199 482 2206 482 2261						 			
5 1937 5 1968 9 8 1943 8 1981 9 24 1965 24 2002 9 145 2068 145 2116 9 194 2095 194 2142 194 318 2147 318 2199 194 482 2266 482 2261 194						-		 	
8 1943 8 1981 24 1965 24 2002 145 2068 145 2116 194 2095 194 2142 318 2147 318 2199 482 2206 482 2261			-					 	
24 1965 24 2002									
145 2068 145 2116 194 2095 194 2142 318 2147 318 2199 482 2261		The second second						 	
194 2095 194 2142 318 2147 318 2199 482 2206 482 2261									
318 2147 316 2199 482 2206 482 2261									
482 2206 482 2261				318					
530.4 2191 530.4 2248				482	2261			Ť	
	530.4	2191		530.4					
		<u></u>					 	<u> </u>	
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Recovery Recovery Recovery	Recovery			Recovery			Recovery		
0 308 Load off 0 376 Load off	0	308	Losd off	0	376	Load off	1		<u> </u>
1 286 1 314				1					

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AFR-800

Tage	Creep		Test	Creep	1	Tage	Creep	
						1		
į.	: 90°		Orient: 90°		Orient: 90°			
1	No: F7-3		Spec.	No: <u>F8-7</u>		1	No: <u>F9-8</u>	
Temp:	72°F(2	2°C)	Temp	72°F(22	°C)	Temp	72°F(22°	c)
Stress: 2.29 ksi 50 t ult.		i 50 t ult.	Stress	2.29 ks	50 % ult.	Stress	2.29 ks	50 % ult.
Elap.	Accum.		Elap.	Accum.		Elap.	Accum.	_
Time	Strain	Remarks	Time	Strain	Remarks	Time	Strain	Remarks
(BFS.)	(# in/in)			(#in/in)		(hrs.)	(µin/in)	
0.017			0	1486		0	1543	
0.10	1547		0.017	1500		0.017	1553	
0.25	1552		0.10	1514		0.10	1567	
0.50			0.25	1520		0.25	1579 1581	
	1563		0.50	1528		1	1591	
1	1565		1 2	1534 1548		2		
3	1583					-	1599	
5	1599 1616	 	5	1568 1582		5	1618 1630	
6	1619		6	1588		6	1638	
7	1627	 	7	1589		7	1640	
8	1627		8	1594		8	1644	
24	1642		24	1608		24	1660	
72	1670		72	1634_		72	1688	
148	1680		145	1645		145	1702	
245	1687		245	1735		245	1806	
435	1828		435	1790		435	1857	
482	1864		482	1821		482	1885	
602	1913		602	1874		602	1959	
	<u></u>			<u></u>		ļ		
				<u> </u>				
		<u></u>						
	Recover	y		Recovery			Recovery	·
0	428	Load off	0	403	Lozd off	0	420	Load off
	390	<u> </u>	1	363		1_1	374	-
3	378	 		351		3	358	
	L			<u> </u>		L	<u> </u>	<u> </u>

APR-300

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Test:	Creep		Test: Craep		Test: Creep				
Orient	Orient: 90*			Orient: 90°			Orient: 90*		
Spec. 1	lo: <u>r9-</u>	7	Spec. No: P12-4			Spec. No: #7-5			
Temp:	260°F(1	27°C)	Temp:	260°F(1	27°C)	1	260°F(1		
1		11 60 % ult.			60 % ult.	į	2.80 ksi	1	
Elap. Time (hrs.)	Accum. Strain (µ in/in)	Remarks	Elsp. Time (hrs.)				Remedia		
0		ge failed	0	2215		٥	failed on	loading:	
	on.	oading	0.10	2193					
556	specimen .	did not fail	0.25	2185					
			0.50		failure				
								:	
-						-			
-						-			
								1	
	<u></u>								
		1							
	L				L	 			
	Recover	7		Recovery	-	<u> </u>	Recovery		
									
	<u> </u>								
	<u> </u>			L	L	<u>لــــــا</u>		<u> </u>	

APR-800 Test: Creep Test: Test Creep Скеер 90° Orient: 90° Orient: Spec. No. F7-10 Spec. No: F11-10 260°F(127°C) Temp: 260°F(127°C) Temp: Stress: 2.57 wsi 55 % ult. Stress: 2.57 ksi 55 % ult. Elap. Accum. Elap. Accum. Time Strain Remarks Time Strain Remarks (# in/in) (Fin/in) (227 8..) (hr s.) 0 1954 1916 0.017 1992 0.017 1941 0.10 2009 0.10 1994 2102 0.33 2009 0.33 0.50 2135 0.50 2017 2037 2169 2037 2217 3 3 2040 2233 5 2049 2267 2037 6 2279 7 2037 2293 24.3 2408 24.3 2003 72 1990 72 2560 144 144 2019 2696 240 2046 240 2854 313 313 2064 2940 408 2092 408 3053 506 3155 506 Recovery Recovery Load off 209 Q 1380 Load off 147 1292 1249 126

rest;_	Catego							
Orient: 90°								
Spec. No: P14-5								
Temp: 260°F(127°C)								
Stress 2.57 ksi 55 t ult.								
Elap.	Accum.							
Time	Strain	Remarks						
(brs.)	(µin/in)							
0	1955							
0.017	1966							
0.10	1976							
0.33	2031							
2.50	2034							
1	2059							
2	2082							
3	2091							
5	2100							
6	2105							
7	2106							
24.3	2109							
72	2143							
144	2190							
240	2272_							
313	2319							
408	2340							
506	2393							
	Recovery							
0	501	Load off						
1	409							
3	375							

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Test: 90* Orient: Spec. No: P7-11 Temp: 260°F(127°C) Stress: 2.34 ksi 50 % ult. Elap. Accum. Time Strain Remarks (hrs.) (# in/in) 0 1937 0.017 1973 0.10 2006 0.25 2050 0.50 2062 2082 2105 2142 5 2157 6 2163 7 2172 28 2286 55 2408 287 2808 462 3013 508 3056

Recovery

1080

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ioad off

Orient	: 90*						
Spec. No: P9-4							
Temp: 260°F(127°C)							
	2.34 kg	30 4 444					
Elap. Time	Accum. Strain	Remarks					
(hrs.)	(Pin/in)						
0	1731						
0.017	1756						
0.10	1766						
0.25	1799						
0.50	1801						
1	1814						
2	1829						
4	1837						
5	1838						
6	1831						
7	1836						
28	1868						
55	1870						
287	1941						
462	1952						
508	1954						
	· - · · - · - · - · - · - · - · - · - ·						
		 					
		 					
 							
	Recovery						
0	209	Load off					
1	183						
2	168						
3	163						

Test:	Test: Creep								
Orient	Orient: 90°								
Spec.	No: F13-	9							
Temp	Temp: 260°F(127°C)								
Stress	2.34 kSi	50 % wit.							
-	Elap. Accum.								
Time	Strain	Remarks							
	(µin/in).								
0	1762								
0.017	1781								
0.10	1791								
0.25									
0.50	1809								
1	1817								
2	1816								
4	1819								
5	1825								
6 .	1827								
7	1827								
28	1906								
55	1.952								
287	2146								
462	2214								
508	2244								
	,								
ļ									
 									
-									
 	<u> </u>								
	Recovery								
0	708	Load off							
1	662								
1	653								
3	639								

APR-800

Test:	Test: Oreap Test: Creep			Test: Creep					
Orient	Orient: 90°			90-	0= Orient: 90°				
Spec. N	Spec. Na: F34-1			Spec. No: F34-8			Spec. No: F34-2		
Temp:	Temp: 350°F(177°C)			350°P(1	77°C)	Temp	350°P(1	77 ° C)	
Stress	: 2.71 ks	d 50% ult.	Strees	2.71 13	i_50% ult.	Street	2.71 ks	_50% tilt.	
Time	Accum. Strain (# in/in)	Remarks	Time	Accum. Strain (#in/in)	Remarks	Elap. Time (hrs.)		Remarks	
0	2319		0	5412		0	failed o	loading	
0.017	2398		0.017		failure				
0.10	3401								
0.25	3860								
0.50	41.12								
1	4800								
2	5052								
3	5084								
4	5059								
5	5070								
6	5065								
24	5374								
68		failure							
				<u> </u>					
	····								
		 							
		 		 	 		 		
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		 		 -					
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	Recover	y		Recovery		Recovery			
		T							
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Test	Crosn		Test:	AFH-900		Test	7==×=	
1	Test: Creep		Test: Creep		Test: Creso			
(Orient: 90°		Orient: 90°		Orient: 90°			
	No:F34-		ŧ	No: F34-5		i	No: F34-1	
Temp:	350 °F(1	.77°C)	Temp:	350°F(1	77 °C)	Temp	350°F(1	77 °C)
Stress	: 2.17 ks	<u>i 40</u>		2.17 ES	40 t ult.	Stress	2.17 ks	40% ult.
Elap.	Accum.		Elap.	f :	_	Elap.	Accum.	
Time	Strain	Remarks	Time	Strain	Remarks	Time	Strain	Remarks
(hrs.)			(hrs.)			(brs.)	(µin/in)	
0	1902		0	1801		0	2830	
0.017	2069		0.017	1902		0.017	3188	
0.10	2342		0.13	1954		0.03		failure
0.25	2519		0.25	1954				
0.50	2631		0.50	1981				
1	2713	<u> </u>	1	2023				
3	2740		2	2091				
4	2788		4	2157				
5	2764		5	2182				
6	2780			2225				
24	2720		24	2464				
122	2804		168	3289				
195	2951		267	3694				
205		failure	335	3929				
			437	4282				
			528	4580				
				<u> </u>				
-								
				 				
		 		ļ <u> </u>				
				 				
 		 -				 		-
 	 	 		 				
				<u> </u>	!		8	
	Recover	7	Recovery				Recovery	
	<u> </u>]	0	2801	Load off		ļ	
			1	2652			<u> </u>	ļI
		} _	- 3	2626				
L	<u> </u>		4.5	2545	L	l L	<u> </u>	<u> </u>

Test: Creep Test: Orient: 90° Spec. No: F34~7 Temp: 350°F(177°C) Stress: 1.63 ksi 30 % ult. Elap. Accum. Strain RemarksTime (hrs.) (# im/in) 0 2230 0 - 1000 0.017 2245 0.10 2277 0.25 2365 0.50 2371 2468 2589 5.2 2731 2754 2701 48 2689 52 3091 72 3289 145 3618 240 3760 312 3900 414 4140 505 4164 Recovery 2876 Load off 1 2529 2 2365 4.5 2198

Test: Creep								
Orient: 90 ·								
Spec. No: F34-9								
Temp:	350°F(<u>.77 °C)</u>						
	1.63	30% ult.						
Elap. Accum.								
Time	Strain	Remarks						
(hrs.)	(#in/in)							
0	1108							
0.017	1108							
0.10	1134							
0.25	1161							
0.50	1243							
1	1323							
2	1389							
5.2	1511							
-6	1538							
7	1631							
48	2492							
72	2597							
145	2893							
240	3392							
312	3717							
414	4218							
505	4472							
		<u> </u>						
	Recovery							
<u> </u>	3315	Load off						
	3035							
2	2964							
4.5	2736							

Test:	Creep								
	:: 90°								
Spec. No: F34-10									
Temp	350°F(17	7°C)							
Stress	Stress 1.63 ksi30 tult.								
Elap.	Accum.								
Time	Strain	Remarks							
(hrs.)	(µin/in)								
0	2468								
0.017	2591								
0.10	2777								
0.25	2828								
0.50	2985								
1_	3085								
. 2	3231								
5,2	3477								
6	3524								
7	3581								
48	4480								
72	4677								
143	5215								
240	5932								
312	6426								
414	7348								
505	8057								
	~								
	<u> </u>								
	Recovery								
<u> </u>	6471	Load off							
1	6965								
2	6013	ļ							
4.5	5892								

Test: Creep ±45° Orient: Spec. No: F28-10 72°F (22°C) Temp: Stress: 16.27 ksi 70% ult. Elap. Accum. Time Strain Remarks (µ in/in) (hrs.) 0 8330 0.017 8690 0.117 9214 9456 0.50 9634 1 9867 2 10054 24 10924 91 11508 131 11684 183 12028 260 12148 361 12275 453 12351 528 12387 Recovery Load off O 3840 1 2445 1.5 2362

Orient: <u>+45</u> *							
Spec. No: F29-3							
Temp: 72°F(22°C)							
Stress: 16.27 ksi 70 ult.							
Elap.	Accum.						
Time	Strain	Remarks					
(hrs.)	(Pin/in)						
0	8610						
0.017	8940						
0.117	9459						
0.25	9710						
0.50	9895						
1	10140						
2	10333						
24	11,225						
91	11820	,					
131	12000						
1.83	12343						
260	12455						
361	12588						
453	12656						
528	12689						

	1						
	Recovery						
C	4020	Load off					
1	2433						
1.5	2347						
<u> </u>	<u> </u>	<u> </u>					

AFR-800

Creep

Test:

	Creep						
Orient: ±45°							
Spec.	No: F33-9						
Temp	72°F(2	?*c)					
Stress	16.27 ksi						
Elap.	Accum.						
Time	Strain	Remarks					
(hrs.)	(µin/in)						
0	8090						
0.017	8350						
0.117	8845						
0.25	9090						
0.50	9273						
1	9507						
2	9692						
24	10585						
91	11175						
131	11354						
183	11692						
260	11815						
361	11954						
453	12033						
528	12072						
L							
		<u></u>					
	<u> </u>						
	ļ						
	<u> </u>						
	<u> </u>	<u> </u>					
	Recovery	·					
0	4430	Load off					
1	2647						
1.5	2564						
1		l					

				AFR-BO					
	Creep			Creep		Test:	Creep		
Orient: +45°			Orient: +45°			Orient: +45°			
Spec. 1	No: F23-2		Spec. I	No: F23-	4	Spec.	No: F25-2	معتمد شاسب ، دراوی	
Temp: 72°F(22°C)			Temp:	72°F(22	*c)	Temp	72°F(2	2°C)	
Stress	13.94 kS	i_60\$ ult.	Stress	13.94 ks	i_60 9 ult.	Stress	13.94 ksi	60 % ult.	
Elap. Time	Accum. Strain	Remarks	Elap. Time	Accum. Strain	Remarks	Elap. Time	Accum. Strain	Remarks	
(hrs.)		; ;	(hrs.)			(hrs.)			
0	6540		0	6449		0	6457		
0.017	6653		0.017	6543		0.017	6536		
0.10	6779		0.10	6630		0.10	6620		
0.25	6935		0.25	6747		0.25	6778		
0.583	7235		0.583	7036		0.583	7064		
1	7297		1	7114		1	7129		
2	7450		2	7230		2	7280		
3	7542		3	7294		3	7371		
5.2	7601		5.2	7362		5.2	7378		
7.2	7654		7.2	7392		7.2	7497		
47.4	8187	4112	47.4	7887		47.4	7874		
148	8725		148	8376		148	8478		
217	8793		217	8440		217	8546		
366	9254		366	8894		366	8978		
413	9267	4127	413	8895		413	8989		
480	9362		480	8967		480	9067		
503	9404		503	9001		503	9119		
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	Recover	y		Recovery			Recovery		
0	2674	Load off	0	2336	Load off	0	2400	Load off	
ı	1972		1	1911		1	1908		
2	1932		2	1760		2	1864		

AFR-800

Test:_	Creep		Test:	Creep		· · ·	Creep	
Orient	±45°		Orient	: +45°		Orient	<u>+45°</u>	
Spec. N	io: F24-2		Spec. I	No: F27-	2	Spec. I	No: F27-	7
Temp:	72°F(22	°C)	Temp:	72°F(22°C)	Temp:	72°F (22	*c)
Stress	Stress: 11.62ksi 50 % ult.			Stress: 11.62 ksi 50 % ult.			11.62 ksi	50 t uit.
Elap.	Accum.		Elap.	Accum.		Elap.	Accum.	
Time	Strain	Remarks	Time	Strain	Remarks	Time	Strain	Remarks
(hrs.)	$(\mu in/in)$		(hrs.)	(Pin/in)		(hrs.)	(gin/in)	
0	5320		0	6225		0	5412	
0.017	5461		0.017	6351		0.017	5485	
0.10	5617		0.10	6556		0.10	5620	
0.25	5696		0.25	6676		0.25	5693	
0.50	5770		0.50	6785	-	0.50	5770	
1	58 6 9		1	6907		1	5860	
2	5942		2	7024		2	5944	
4	6046		4	7160		4	6025	
5	6071		5	7203		5	6057	
6	6082		6	7230		6	6072	
7	6110		7	7277		7	6112	
28.5	6418		28.5	7670		28.5	6412	
55	6551		55	7852		55	6544	
287	6836		287	8294		287	6952	
462	7120		462	8641		462	7240	
508	7115		508	8688		508	7293	
						·		
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						 	<u> </u>	
Recovery		Recovery] [Recovery	•	
Q	1582	Load off	٥	2320	Load off	0	1725	Load off
1	1051	<u> </u>	11	1532	<u> </u>	┤	1086	
2	967	<u> </u>	2	1382	 	│	983	
3	945	<u> </u>	3	1357	<u> </u>]	921	<u> </u>

AFR-800

				AFR-800					
Test:	Creep		Test:_	Creer		Test:	Creep		
Orient	<u>+45*</u>		Orient	: <u>±45°</u>		i	Orient: ±45°		
Spec. N	lo:F29-		Spec. 1	No: P30-	7	Spec.	No: F32-2		
Temp:	260°F(127°C)	Temp	260°F	127°C)	Temp	260°F(1	27 °C)	
Stress: 13.44 kmi 80% ult.			Stress	13.44 ks	80 ult.	Stress	13.44 ksi	80 t ult.	
Elap. Time	Accum. Strain	Remarks	Elap. Time	Accum. Strain	Remarks	Elap. Time	Elap. Accum. Time Strain Remark		
(hrs.)	(µ in/in)		(hrs.)	(#in/in)			(µin/in)		
0	12578		0	12083		0	Gage fai	lure	
0.017	15152		0.017	13405		0.25		failure	
0.10	18404		0.10	15543					
0.167	19291		0.167	16362					
0.25	44.0	failure	0.25	16876	failure				
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	Recover	<u>'</u>		Recovery			Recovery		
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				AFR-800)		
Test:	Creep		Test:	Creep		Test:	
Orient	: <u>+45</u> °		Orient	: <u>+45°</u>		Orient	::
Spec. 1	No: F30-1	1	Spec.	No: F32-	3	Spec.	No:_
Temp:	260°F(1	27°C)	Temp:	260°F(1	7°C)	Temp	260
Stress	: 11.76 ks	i 70 % ult.	Stress	11.76	70 t ult.	Stress	11.
Elap. Time (hrs.)	Accum. Strain (# in/in)	Remarks	Elap. Time (hrs.)	Accum. Strain (#in/in)	Remarks	Elap. Time (hrs.)	Αc St: (μi
0	7818		0	7917		0	- 15
0.017	9154		0.017	8917		0.017	7
0.10	10116		0.10	10174		0.10	
0.25	10805		0.25	11010		0.25	
0.50	11275		0.50	11470		0.50	
1	11857		1	11975		1	
2	12437		2	12499		2	,
2.5	12635		2.5	12678		2.5	10
4.5	13160		4.5	13169		4,5	10
5.5	13331		5.5	13335		5.5	10
6.6	13480		6.6	13498		6.6	10
7.5	13585		7.5	13602		7.5	10
24	14538		24	14634		24	13
48	14180		48	15440		48	12
74	16238		74	15977		74	1:
144	17074		144	16921		144	1.7
366	18704		366	19213		366	1.5
484	19334		494	20176		484	15
506	19474		506	20350		506	15
				i			
	Recover	у		Recovery			Rec
0	13529	Load off	0		Load off	0	
2.3	11777		2.3	12437	ļ	2.3	
3	11627		3	12266		3	
4	11517		4	12170		4	

Test: Creep Crient: ±45° Spec. No: F33-2 Temp: 260°F(127°C) Stress 11.76 ksi 70° ult. Flap. Accum. Strain (μin/in) 0 5433 0.017 7155 0.10 8184 0.25 8719 0.50 9085 1 9469 2 9926 2.5 10077 4.5 10542 5.5 10077 4.5 10930 24 11512 48 12349 74 12830 144 13815 366 15390 484 15898 506 15986 Recovery 0 10766 Load off 2.3 10014									
Spec. No: F33-2 Temp: 260°F(127°C) Stress 11.76 ksi 70° ult. Elap. Accum. Remarks (µin/in) 0 5433 0.017 7155 0.10 8184 0.25 8719 0.50 9085 1 9469 2 9926 2.5 10077 4.5 10542 5.5 10701 6.6 10840 7.5 10930 24 11512 48 12349 74 12830 144 13815 366 15390 484 15898 506 15986 Recovery 0 10766 Load off 2.3 10014									
Temp: 260°F(127°C) Stress 11.76 ksi 70° ult. Elap. Accum. Strain (μin/in) 0 5433 0.017 7155 0.10 8184 0.25 8719 0.50 9085 1 9469 2 9926 2.5 10077 4.5 10542 5.5 10701 6.6 10840 7.5 10930 24 11512 48 12349 74 12830 144 13815 366 15390 484 15898 506 15986		·							
Stress 11.76 ksi 70 tult. Elap. Accum. Time Strain (µin/in) 0 5433 0.017 7155 0.10 8184 0.25 8719 0.50 9085 1 9469 2 9926 2.5 10077 4.5 10542 5.5 10701 6.6 10840 7.5 10930 24 11512 48 12349 74 12830 144 13815 366 15390 484 15898 506 15986	Spec.	No: <u>F33-2</u>							
Elap. Strain (μin/in) 0 5433 0.017 7155 0.10 8184 0.25 8719 0.50 9085 1 9469 2 9926 2.5 10077 4.5 10542 5.5 10701 6.6 10840 7.5 10930 24 11512 48 12349 74 12830 144 13815 366 15390 484 15898 506 15986	Temp	260°F(127	*C)						
Time (\(\mu\)in (\(\mu\)in in (\(\mu\)in in (\(\mu\)in in in in (\(\mu\)in in i	Stress	11.76 ksi	70 tult.						
Time (\(\mu\)in (\(\mu\)in in (\(\mu\)in in (\(\mu\)in in in in (\(\mu\)in in i	Elap.	Accum.							
0 5433 0.017 7155 0.10 8184 0.25 8719 0.50 9085 1 9469 2 9926 2.5 10077 4.5 10542 5.5 10701 6.6 10840 7.5 10930 24 11512 48 12349 74 12830 144 13815 366 15390 484 15898 506 15986 Recovery 0 10766 Load off 2.3 10014		Strain	Remarks						
0.017 7155 0.10 8184 0.25 8719 0.50 9085 1 9469 2 9926 2.5 10077 4.5 10542 5.5 10701 6.6 10840 7.5 10930 24 11512 48 12349 74 12830 144 13815 366 15390 484 15898 506 15986 8 15986 8 15986 8 15986	(hrs.)	(µin/in)							
0.10 8184 0.25 9719 0.50 9085 1 9469 2 9926 2.5 10077 4.5 10542 5.5 10701 6.6 10840 7.5 10930 24 11512 48 12349 74 12830 144 13815 366 15390 484 15898 506 15986 Recovery 0 10766 Load off 2.3 10014	o	5433							
0.25 8719 0.50 9085 1 9469 2 9926 2.5 10077 4.5 10542 5.5 10701 6.6 10840 7.5 10930 24 11512 48 12349 74 12830 144 13815 366 15390 484 15898 506 15986 Recovery 0 10766 Load off 2.3 10014	0.017	7155							
0.50 9085 1 9469 2 9926 2.5 10077 4.5 10542 5.5 10701 6.6 10840 7.5 10930 24 11512 48 12349 74 12830 144 13815 366 15390 484 15898 506 15986 Recovery 0 10766 Load off 2.3 10014	0.10	8184							
0.50 9085 1 9469 2 9926 2.5 10077 4.5 10542 5.5 10701 6.6 10840 7.5 10930 24 11512 48 12349 74 12830 144 13815 366 15390 484 15898 506 15986 Recovery 0 10766 Load off 2.3 10014	0.25	8719							
1 9469 2 9926 2.5 10077 4.5 10542 5.5 10701 6.6 10840 7.5 10930 24 11512 48 12349 74 12830 144 13815 366 15390 484 15898 506 15986 Recovery 0 10766 Load off 2.3 10014	0.50	9085							
2 9926 2.5 10077 4.5 10542 5.5 10701 6.6 10840 7.5 10930 24 11512 48 12349 74 12830 144 13815 366 15390 484 15898 506 15986 Recovery 0 10766 Load off 2.3 10014	1								
4.5 10542 5.5 10701 6.6 10840 7.5 10930 24 11512 48 12349 74 12830 144 13815 366 15390 484 15898 506 15986 Recovery 0 10766 Load off 2.3 10014	2	9926							
4.5 10542 5.5 10701 6.6 10840 7.5 10930 24 11512 48 12349 74 12830 144 13815 366 15390 484 15898 506 15986 Recovery 0 10766 Load off 2.3 10014	2.5	10077							
5.5 10701		10542							
6.6 10840 7.5 10930 24 11512 48 12349 74 12830 144 13815 366 15390 484 15898 506 15986 Recovery 0 10766 Load off 2.3 10014									
7.5 10930 24 11512 48 12349 74 12830 144 13815 366 15390 484 15898 506 15986 Recovery 0 10766 Load off 2.3 10014		10840							
24 11512		10930							
74 12830 144 13815 366 15390 484 15898 506 15986									
144 13815	48	12349							
366 15390 484 15898 506 15986 506 506 506 506 506 506 506 506 506 50	74	12830							
484 15898 506 15986	144	13815							
506 15986	366	15390							
Recovery 0 10766 Load off 2.3 10014	484	15898							
0 10766 Load off 2.3 10014	506	15986							
0 10766 Load off 2.3 10014									
0 10766 Load off 2.3 10014									
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0 10766 Load off 2.3 10014									
0 10766 Load off 2.3 10014									
0 10766 Load off 2.3 10014									
2.3 10014		Recovery							
2.3 10014	0	10766	Load off						
3 3001	2.3								
	3	9904							
4 9790	4	9790							

	Creep			Croec			Creep		
Orient	+45°		Orient	: +4 5°		Orien	Orient: +45*		
Spec. 1	No: P26-	-3	Spec. 1	No: F26-5		Spec.	Spec. No: F26-9		
Temp:	260°F(12	27°C)	Temp	260°F(1	27°C)	Temp	Temp: 260°F(127°C)		
Strass	trass: 10.08 ksi60 % ult.			10.06 13	igo wit.	Stress	5 10.08 kg	60 tult.	
Elap.	Accum.		Elap.	Accum.	,	Elap.	Accum.		
Time	Strain	Remarks	Time	Strain	Remarks	Time		Remarks	
(hrs.)	(µ in/in)		(hrs.)	(#in/in)		(hrs.)	(uin/in)		
0	5039		0	4987		0	6025		
0.017	5212		0.017	5161		0.017	6228		
0.10	5585		0.10	5392		0.10	6950		
0.25	5788		0.25	5580		0.25	7249		
0.50	5973		0.50	5802		0.42	7434		
1	6197		1	6055		0.50	7504		
2	6426		2	6342		1	7799		
4	6685		4	6663		2	8175		
5	6768		5	6774		4	8580		
6	6833		6	6862		5	9214		
7	6959		7	6954		6	9624		
24	7576		24	7649		7	10001		
48	7891		48	8409		24	12067		
120	8463		120	9551		48	13482		
216	8955		216	10517		120	15606		
314	9317		314	11308		216	17545		
385	9572		385	11839		314	19022		
528	9958		528	12690		385	19931		
						528	21504		
								į	
					<u> </u>				
							<u> </u>		
Recovery		Recovery				Recovery			
0	5166	Load off	<u>Q</u>	7707	Load off		15676	Load off	
1	4362		1	6473	 	<u> </u>	13988		
- 2	4217	<u> </u>	2	6168	 	2	1.3611		
<u> </u>	4058		1_4	5910	<u> </u>] _1_	13266		

APR-800

Test: Creev	Test: Creep	Test: Creso			
Orient: 445*	Orient: +45*	Orient: +45°			
Spec. No: F24-8	Spec. No: F26-7	Spec. No: F26-11			
Temp: 350°F(177°C)	Temp: 356*F(177*C)	Temp: 350°F(177°C)			
Stress: 9.76 ksi60 t ult.	Stress: 9.76 psi 60 % ult.	Stress 9.76 ksi 60 % ult.			
Elap. Accum.	Elap. Accum.	Elap. Accum.			
Time Strain Remarks	Time Strain Remarks	Time Strain Remarks			
(hrs.) (# in/in)	(hrs.) (Pin/in)	(hrs.) (µin/in)			
0 gage failed	0 7442	0 missed initial reading			
222 specimen failed	0.083 8438	0.10 10281			
	0.167 9321	0.167 10628			
	0.50 12195	0-50 11774			
	1 18526	1 12635			
	1.5 20000 (approx.)	2 13634			
	2 gage failed	3 14492			
	25 specimen failed	4 15633			
		5 16717			
		6 17527			
		24 gage failed			
		222 specimen overheated			
		and failed when			
		F24-8 failed			
Recovery	Recovery	Recovery			
					
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Test: Creep		Test			Tace		
· ·		Test: Creen			Test: Creep		
Orient: ±45*	1 1		±45°	1 1			
Spec. No: P29-5		-	io: F30-8		Spec. No: F33-7		
Temp: 350°F(177°	(c)	Temp:	350°F(17	ブ*じ)	Temp	350°F(1	77°C)
Stress: 8.14 ksi 5	03 ult.	Stress:	8.14 hai	50 t ult.	Stress	<u>8.14</u> kSi	<u>50</u> % ult.
Elap. Accum.		Elap. Accum.		Elap.	Accum.		
	1 1	Time	Strain	Remarks	Time	Strain	Remarks
(hrs.) (# in/in)		(hrs.)	(Pin/in)		(hrs.)	(µin/in)	
0 7763		0	8596		0	7137	
0.017 11070		0.017	gage fai	led	0.017	8299	
0.10 16046		504	no fail	uxe	0.10	9999	
0.25 17873					0.25	11090	
0.50 19734					0.50	12112	
1 21746					1	14119	
2.1 24062					2.1	17002	
4 25246					4	19408	
5 26939					5	20156	
6 27685					6	20883	
7 28179					7	21322	
24 33711					24	gage fa	iled
100 gage ai	led				504	no fail	ure
504 no failu							
		1					
		1					
			بالريطان بيرين الم				
Recovery		Recovery				Recovery	
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Test:	Test: Creep			Test: Creep			Test: Creep		
1			Orient: +45°			Orient: ±45°			
I	: +45°		. 1			l .			
ŧ	io: <u>F27-9</u>	1		No: P28-1		1	No: F33-11		
Temp:	350°F(1	77°C)	. }	350°F		1	350°F(17		
Stress	: 6.51 ks	i 40 % ult.	Stress	Stress: 6.51 Hai 40 % ult.			6.51 ks	40% ult.	
Elap.	Accum.		Elap.						
Time	Strain	Remarks	Time	Strain	Remarks	Time	Strain	Remarks	
(hrs.)				(Fin/in)		(hrs.)			
0	6939		0	9778		0	23065		
0.017	9187		0.017	14448		0.017	gage fai		
0.083	10704		0.083	20391		432	fail	re	
0.10	10930		6.10	20406					
0.28	14452		0.28	22333					
0.50	16101		0.50	24471		·			
1	17879		1	25544					
2	19196		2	26425					
3	20120		3	26997					
4.5	20789		4.5	27218					
5	20151		. 2	27291					
6	21459		- 6	27400					
24	28191		24	28211					
96	30668		96	29824					
121.3	33593		121.3	30563			<u> </u>		
167	g a ge	failed	167	32137					
504	no fai	ure	191	32580					
<u> </u>			264	gage f	iled				
			504	no fai.	ure				
						 			
									
							<u> </u>		
				<u> </u>		 			
	<u></u>				<u></u>				
									
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	Recover	y		Recovery	,		Recovery	,	
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Test:	Creep		Test: Creep			Test: Creep			
Orient	+45*		Orient	: #45"		Orient	±45*		
Spec. 1	lo: <u>628-7</u>		Spec.	No: <u>G29</u> -	3	Spec.	No: G30-4		
Temp:	72*F(22	:°C)	Temp:	72*F(22*	c)	Temp	72°F(22	*c)	
Stress	: 13.86 ks	<u>i 80% ult.</u>	Stress	Stress: 13,96 kmi 80% ult.			<u>13.86</u> ksi	<u>80</u> % ult.	
Elap. Time (hrs.)	Accum. Strain (µ in/in)	Remarks	Time	Accum. Strain (#in/in)	Remarks	Elap. Time (hrs.)	Accum. Strain (µin/in)	Remarks	
0	7790		0	8350		0	8180		
0.017	8352		0.017	8935		0.017	8730		
0.10	9077		0.10	9718		0.10	9837		
0.25	9634		0.25	10303		0.25	10545		
0.50	10053		0.50	10817		0.50	11206		
1	10545		1	11387		1	11884		
2	11069		2	11989		2	12818		
6.5	12079		6.5	13187		6.5	gage out		
7	12211		7	13335		534	no failur		
25	13414		25	14740					
145	15490		145	17384					
312	16368		312	18487					
360	16566		360	18740					
438	16851		438	19120					
534	17166		534	19533					
 									
									
					 				
				 -					
	Recovery Recovery				Recovery				
0	10178	Load off	0	11830	Load off				
1	7640		1	9169					
1.5	7433		1.5	952					
	<u> </u>			<u> </u>	L		<u> </u>	<u> </u>	

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Test: Craep Orient: ±45° Spec. No: G27-7 Temp: 72°F(22°C) Stress: 12.13 ksi 70 * ult. Test: Craep Orient: ±45° Spec. No: G27-8 Temp: 72°F(22°C) Stress: 12.13 ksi 70 * ult.	Orien Spec. Temp	Creep t: <u>+45°</u> No: <u>628-</u> : : 72°F(22°		
Spec. No: G27-7 Spec. No: G27-8 Temp: 72*F(22*C) Temp: 72*F(22*C) Stress: 12.13 ksi 70 * ult. Stress: 12.13 ksi 70 * ult.	Spec.	No: <u>G28-</u> ;		
Temp: 72°F(22°C) Temp: 72°F(22°C) Stress: 12.13 ksi 76 % ult. Stress: 12.13 ksi 76 % ult.	Temp	: 72°¥(22°		
Stress: 12.13 kSi 70 % ult. Stress: 12.13 kSi 70 % ult.	ĺ		ا ١٠٠١	
	Stres			
1 m 1 4 m 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Stress 12.13 Hai 70 % ult.			
Elap. Accum. Elap. Accum.	Elap. Accum.			
Time Strain Remarks Time Strain Remarks	Time		Remarks	
(hrs.) (# in/in) (hrs.) (#in/in)	(hrs.)	(µin/in)		
0 5299 0 5367	0	5700		
0.017 5767 0.017 5681	0.017	6318		
0.10 6167 0.10 6017	0.10	6897		
0.25 6487 0.25 6297	0.25	7210		
0.50 6729 0.50 6519	0.50	7431		
1 7004 1 6764	1	7708		
2 2 7033	2	8023		
4.3 7698 4.3 7379	25	9189		
5 7792 S 7460	146	10330		
6 7885 6 7543	192	10645		
7 7947 7 7597	360	11248		
24 8627 24 8175	453	11457		
48 9045 48 8514	504	11555		
192 10001 192 9380				
360 10501 360 9706				
408 10590 408 9773				
486 10735 486 9379				
533 10808 533 9928				
				
Recovery Recovery		Recovery		
0 5500 Load off 0 5010 Load off	0	5640	Load off	
1 4214 1 3615		3887		
2 3978 2 3382	2	3600	 	
2.5 3913 2.5 3314	<u> </u>	<u> </u>	<u></u>	

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Test:			,	Creep		Test:	Creep	
Orient	<u>+45*</u>		Orient	<u>+45*</u>		Orient	: <u>+45</u> •	
Spec. N	ta: C16-6		Spec. 1	Vo: 629-2		Spec. 1	No: G31-1	
Temp:	72°F(22	°C)	Temp:	72°F(22°	'C)	Temp	72°F(22°	<u>(C)</u>
Stress	Stress: 10.39 ksi 60 % ult.			Stress: 10.39 hai 60 % ult.			10.3915	60 t ult.
Elap.	Accum.		Elap.	Accum.		Elap.	Accum.	
Time	Strain	Remarks	Time	Strain	Remarks	Time	Strain	Remarks
(hrs.)	(<i>p</i> in/in)		(hrs.)	(Pin/in)		(hrs.)	(µin/in)	
0	5110		0	5320		0	5312	
0.017	5338		0.017	5541		0.017	5493	
0.10	5776		0.10	6008		0.10	5900	
0.25	6025		0.25	6290		0.25	6161	
0.50	6224		0.50	6506		0.50	6362	
1	6435		1	6744		1	6581	
1.5	6550		1.5	6873		1.5	6701	
4	6939		4	7316		4	7102	
6	7130		6	752 5		6	7297	
168	8795		168	9515		168	9068	
412	9140		412	9963		412	9470	
483	9208		483	10050		483	9551	
579	9317		579	10189		579	9677	
			l					
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			<u> </u>					<u></u>
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			l					
					<u> </u>			
		<u> </u>						
					<u> </u>			
						 		
		1		<u> </u>	<u> </u>			
	Recover	У	Recovery		 	Recovery		
0	4320	Load off		4879	Load off	<u> </u>	4650	Load off
1	3066		1	3578		<u> </u>	3227	
2	2860			3350	 	2	3005	
3	2759	<u> </u>	3	3253	<u> </u>] [_3	2910	<u></u>
1	2759		i I <u></u>	3233	<u> </u>	[2910	1

sic/5506

Test: Creep		Test:	Creep		Test: Creep			
Orient: ±45°		, -	±45°		5	Orient: +45°		
Spec. No: GI	2-3	i i	No: G16-5		<u> </u>	No: G31-8		
Temp: 260°7		1 -	260°F(1	27°C)	1	260°F(1		
1	ksi 44 s ult.	1	5.12 kg	i		5.12		
Elap. Accu			Accum					
Time Strai	4 . 1	Elap. Time	1	Remarks	Elap. Time	Accum. Strain	Remarks	
(hrs.) (# in/			(Pin/in)		(hrs.)			
0 5139		0	4157		0	3709		
0.017	gage failed	0.017	4607		0.017	4179		
504	no failure	0.10	5041		0.10	4856		
		0.25	5355		0.25	6093		
		0.50	7752		0.50	7978		
		1	99 56		1	10095		
		2	10858		2	10847		
		25	13778		25	12728		
		146	15715		146	13822		
		192	16119		192	14094		
		360	17398	₹	360	15124		
<u></u>		453	18131		453	15557		
		504	18528		504	15793		
<u></u>								
								
			<u> </u>					
								
			ļ <u></u>					
							 	
			 					
			-				 	
 								
 			 				-	
7						Dagger		
Recovery		Recovery				Recovery		
		Ù	14756	Load off	<u> </u>	13066	load off	
		11	6905		1	12262		
 		2	6486		2	12038		
L		l	1	L.,	L	<u> </u>	L	

				SiC/550	5			
Test:_	Creep		Test:	Creep		Test:	Creep	
Orient	±45°		Orient	<u> +45°</u>		Orient: +45°		
Spec. N	G28-5		Spec. 1	No: <u>G29-7</u>		Spec.	No: G31-6	
Temp:	260°F(1	27°C)	Temp:	260°F(1	27 °C)	Temp	260°F(1	27 °C)
Stress	: <u>8.07</u> ks	<u>i 70 % ult.</u>	Stress	8.07 lcs	i 70 t ult.	Stress	8.07 ksi	70 tult.
Elap. Time	Accum. Strain	Remarks	Elap. Time	Accum. Strain	Remarks	Elap. Time	Accum. Strain	Remarks
(hrs.)			(hrs.)	(#in/in)		(hr:.)	(µin/in)	
0	11579		0	41063		0	11144	
0.017	3.7765		0.317	41063	gage failed	0.017	1.6063	
0.10	20601		7	specimen	failure	0.10	19274	
0.25	21806	<u> </u>		<u></u>		0.25	22144	
0.50	22931					0.50	24287	
1	23930					1	26229	
2	27 3 36	7				2		gage failed
5	32579					92	specimen	failure
6	33463							
7		gage failed						
308	والاشتان كيور	no failure						
								
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	<u></u>							
		 	 					
								
	<u></u>							
·					 		 	
		 						
سرد سست	Recovery			Recovery			Recovery	
**								

sic/5506

Test: Creep	(7 4 -	A		7000	\$10/5506	·····	Tacti				
Spec. No: G12-2 Spec. No: G28-4 Spec. No: G31-5 Temp: 260°F(127°C) Temp: 260°F(127°C) Temp: 260°F(127°C) Stress: 5.76 ksi 50 % ult. Stress: 5.76 ksi 50 % ult. Stress: 5.76 ksi 50 % ult. Elap. Accum. Time Strain Remarks (hrs.) (μ in/in) Time Strain Remarks (hrs.) (μ in/in) Time Strain Remarks (hrs.) (μ in/in) 0 6146 0 0 4266 0 0 4346 0.017 7494 0.017 4771 0.017 5332 0.10 9008 0.10 7824 0.10 11017 0.25 10286 0.25 8960 0.25 12344 0.50 11360 0.50 9755 0.50 13490 1 12640 1 10400 1 14773 2 14219 2 11023 2 16409 4 16280 4 12322 4 17850 5 17045 5 12907 5 18357 6 17695 6 13362 6 18886 7 18144 7 13706 7 19212 24 gage failed 24 16054 24 23204 509 no failure 25 16157 25 23141 26 16288 26 23466 28 16512 28 23724 29 16662	, –]	-			1 1				
Temp: 260°F(127°C) Stress: 5.76 ksi 50 % ult. Elap. Accum. Time Strain Remarks (hrs.) (μ in/in) 0 6146 0.017 7494 0.10 9008 0.25 10286 0.50 11360 0.50 9755 1 12640 1 1 12640 1 1 12640 1 1 12640 1 1 126280 4 1 12322 4 17850 5 17045 6 17695 6 17695 6 17695 7 18144 7 13706 7 19212 24 qage failed 25 16157 26 1628 28 16512 29 16662 29 23854 48 18046 48 18046 48 25767 125 30478 221 34266 125 30478 221 34266 Temp: 260°F(127°C) Stress: 5.76 ksi 50 % ult. Stress: 5.76 ksi 50 kult. Stress: 5.76 ksi 50 % ult. Stress: 5.76 ksi 50 kult. St	Orient	+45"		· j			Orien	t: <u>+45°</u>			
Stress: 5.76 ksi 50 t ult. Stress: 5.76 ksi 50 t ult. Stress 5.76 ksi 50 t ult. Elap. Accum. Time Strain Remarks Flap. Accum. Time Strain Remarks (hrs.) (μ in/in) 0 4266 0 4346 0.017 7494 0.017 4771 0.017 5332 0.10 9008 0.10 7824 0.10 11017 0.25 10286 0.25 8960 0.25 12344 0.50 11360 0.50 9755 0.50 13490 1 12640 1 10400 1 14773 2 14219 2 11023 2 16409 4 16280 4 12322 4 17850 5 17045 5 12907 5 18357 6 17695 6 13362 6 18886 7 18144 7 13706 7 19212	Spec.	No: G12-2		Spec.	No: G28-4		Spec.	No: G31-5			
Elap. Time (hrs.) Accum. (μ in/in) Elap. Time (hrs.) Elap. Strain (hrs.) Remarks (μ in/in) Elap. Time (hrs.)	Temp:	260°F(1	27°C)	Temp	260°F(1	27°C)	Temp	260°F(12	7 °C)		
Time (hrs.) Strain (μ in/in) Remarks (hrs.) Time (hrs.) Strain (μ in/in) Remarks (μ in/in) Time (hrs.) Strain (μ in/in) Remarks (μ in/in) Time (hrs.) (μ in/in) Remarks (μ in/in) Time (hrs.) Time (hrs.) Remarks (μ in/in) Time (hrs.)	Stress	: 5.76 kd	150 % ult.		5.76 ks	50 % ult.	Stress	5.76 ksi	so ult.		
(hrs.) (μ in/in) (hrs.) (μ in/in) (hrs.) (μ in/in) 0 6146 0 4266 0 4346 0.017 7494 0.017 4771 0.017 5332 0.10 9008 0.10 7824 0.10 11017 0.25 10286 0.25 8960 0.25 12344 0.50 11360 0.50 9755 0.50 13490 1 12640 1 10400 1 14773 2 14219 2 11023 2 16409 4 16280 4 12322 4 17850 5 17045 5 12907 5 18357 6 17695 6 13352 6 1886 7 18144 7 13706 7 19212 24 gage failed 24 16054 24 23204 509 no failure 25 16157 25 23141 26 16288 26 23466 2	Elap.	Accum.		Elap.	Accum.		Elap.	, - , ,			
0 6146 0 4266 0 4346 0.017 7494 0.017 4771 0.017 5332 0.10 9008 0.10 7824 0.10 11017 0.25 10286 0.25 8960 0.25 12344 0.50 11360 0.50 9755 0.50 13490 1 12640 1 10400 1 14773 2 14219 2 11023 2 16409 4 16280 4 12322 4 17850 5 17045 5 12907 5 18357 6 17695 6 13362 6 1886 7 18144 7 13706 7 19212 24 qage failed 24 16054 24 23204 509 no failure 25 16157 25 23466 28 16512 28 21724 29 16662 29 23854 48 18046 48	Time	1		Time		Remarks	Time	Strain	Romarks		
0.017 7494 0.017 4771 0.017 5332 0.10 9008 0.10 7824 0.10 11017 0.25 10286 0.25 8960 0.25 12344 0.50 11360 0.50 9755 0.50 13490 1 12640 1 10400 1 14773 2 14219 2 11023 2 16409 4 16280 4 12322 4 17850 5 17045 5 12907 5 18357 6 17695 6 13362 6 18886 7 18144 7 13706 7 19212 24 gage failed 24 16054 24 23204 509 no failure 25 16157 25 23466 28 16512 28 23724 29 16662 29 23854 48 18046 48 25767 125 21956 125 30478 <th>(hrs.)</th> <th>(<i>µ</i> in/in)</th> <th><u> </u></th> <th>(hrs.)</th> <th>(Min/in)</th> <th></th> <th>(hrs.)</th> <th>(µin/in)</th> <th></th>	(hrs.)	(<i>µ</i> in/in)	<u> </u>	(hrs.)	(Min/in)		(hrs.)	(µin/in)			
0.10 9008 0.10 7824 0.10 11017 0.25 10286 0.25 8960 0.25 12344 0.50 11360 0.50 9755 0.50 13490 1 12640 1 10400 1 14773 2 14219 2 11023 2 16409 4 16280 4 12322 4 17850 5 17045 5 12907 5 18357 6 17695 6 13362 6 19886 7 19144 7 13706 7 19212 24 gage failed 24 16054 24 23204 509 no failure 25 16157 25 23141 26 16288 26 23466 28 16512 28 23724 29 16662 29 23854 48 18046 48 25767 125 21956 125 30478 221 25127	0	6146		0	4266		0	4346			
0.25 10286 0.25 8960 0.25 12344 0.50 11360 0.50 9755 0.50 13490 1 12640 1 10400 1 14773 2 14219 2 11023 2 16409 4 16280 4 12322 4 17850 5 17045 5 12907 5 18357 6 17595 6 13362 6 19886 7 18144 7 13706 7 19212 24 gage failed 24 16054 24 23204 509 no failure 25 16157 25 23141 26 16288 26 23466 28 16512 28 23724 29 16662 29 23854 48 18046 48 25767 125 21956 125 30478 221 25127 221 34266	0.017	7494		0.017	4771		0.017	5332			
0.50 11360 0.50 9755 0.50 13490 1 12640 1 10400 1 14773 2 14219 2 11023 2 16409 4 16280 4 12322 4 17850 5 17045 5 12907 5 18357 6 17695 6 13362 6 18886 7 18144 7 13706 7 19212 24 gage failed 24 16054 24 23204 509 no failure 25 16157 25 23141 26 16288 26 23466 28 16512 28 23724 29 16662 29 23854 48 18046 48 25767 125 21956 125 30478 221 25127 221 34266	0.10	9008	<u> </u>	0.10	7824		0.10	11017			
1 12640 1 10400 1 14773 2 14219 2 11023 2 16409 4 16280 4 12322 4 17850 5 17045 5 12907 5 18357 6 17695 6 13362 6 18886 7 18144 7 13706 7 19212 24 gage failed 24 16054 24 23204 509 no failure 25 16157 25 23141 26 16288 26 23466 28 16512 28 23724 29 16662 29 23854 48 18046 48 25767 125 21956 125 30478 221 25127 221 34266	0.25	10286		0.25	8960		0.25	12344			
2 14219 2 11023 2 16409 4 16280 4 12322 4 17850 5 17045 5 12907 5 18357 6 17695 6 13362 6 18886 7 18144 7 13706 7 19212 24 gage failed 24 16054 24 23204 509 no failure 25 16157 25 23141 26 16288 26 23466 28 16512 28 23724 29 16662 29 23954 48 18046 48 25767 125 21956 125 30478 221 25127 221 34266	0.50	11360		0.50	9755		0.50	13490			
4 16280 4 12322 4 17850 5 17045 5 12907 5 18357 6 17695 6 13362 6 18886 7 18144 7 13706 7 19212 24 gage failed 24 16054 24 23204 509 no failure 25 16157 25 23141 26 16288 26 23466 28 16512 28 23724 29 16662 29 23854 48 18046 48 25767 125 21956 125 30478 221 25127 221 34266	1	12640		1	10400		1	14773			
5 17045 5 12907 5 18357 6 17695 6 13362 6 18886 7 18144 7 13706 7 19212 24 gage failed 24 16054 24 23204 509 no failure 25 16157 25 23141 26 16288 26 23466 28 16512 28 23724 29 16662 29 23854 48 18046 48 25767 125 21956 125 30478 221 25127 221 34266	2	14219		2	11023		2				
5 17045 5 12907 5 18357 6 17695 6 13362 6 18886 7 18144 7 13706 7 19212 24 gage failed 24 16054 24 23204 509 no failure 25 16157 25 23141 26 16288 26 23466 28 16512 28 23724 29 16662 29 23854 48 18046 48 25767 125 21956 125 30478 221 25127 221 34266	4	16280		4							
6 17695 6 13362 6 18886 7 18144 7 13706 7 19212 24 gage failed 24 16054 24 23204 509 no failure 25 16157 25 23141 26 16288 26 23466 28 16512 28 23724 29 16662 29 23854 48 18046 48 25767 125 21956 125 30478 221 25127 221 34266	5	17045		5							
7 18144 7 13706 7 19212 24 gage failed 24 16054 24 23204 509 no failure 25 16157 25 23141 26 16288 26 23466 28 16512 28 23724 29 16662 29 23854 48 18046 48 25767 125 21956 125 30478 221 25127 221 34266	6			6			6				
24 gage failed 24 16054 24 23204 509 no failure 25 16157 25 23141 26 16288 26 23466 28 16512 28 23724 29 16662 29 23854 48 18046 48 25767 125 21956 125 30478 221 25127 221 34266	7										
26 16288 26 23466 28 16512 28 23724 29 16662 29 23854 48 18046 48 25767 125 21956 125 30478 221 25127 221 34266	24	gage fa	led	24							
26 16288 26 23466 28 16512 28 23724 29 16662 29 23854 48 18046 48 25767 125 21956 125 30478 221 25127 221 34266	509	no fail	re	25	16157		25	23341			
29 16662 29 23854 48 18046 48 25767 125 21956 125 30478 221 25127 221 34266				26	16288			23466			
29 16662 29 23854 48 18046 48 25767 125 21956 125 30478 221 25127 221 34266				28	16512		28	23724			
48 18046 48 25767 125 21956 125 30478 221 25127 221 34266				29				23854			
221 25127 221 34266				48	18046						
				125	21956		125	30478			
				221	25127		221	34266			
The state of the s					28699		390	38899			
509 31161 509 41791				509	31161		509	41791			
						<u> </u>					
Recovery Recovery		Recovery			Recovery			Recovery	,		
						Load off	-		Load off		
1.5 26301 1.5 35119				-			1.5				
2 26093 2 35838				2	26093	ļ	<u> 2</u>	35838			
	L	<u> </u>			<u> </u>	<u> </u>	ــــا ا	<u></u>			

S1C/5506

	S1C/5506			
Test: Creap	Test: Creep	Test: Creep		
Orient: +45°	Orient: +45°	Orient: +45°		
Spec. No: 612-6	Spec. No: G28-8	Spec. No: G30-2		
Temp: 350 °F(177 °C)	Temp: 350°F(177°C)	Temp: 350°F(177°C)		
Stress: 3.17 ksi 40 % ult.	Stress: 3.17 ksi 40 % ult.	Stress 3.17 ksi 40 % ult.		
Elap. Accum.	Elap. Accum.	Elap. Accum.		
Time Strain Remarks	Time Strain Remarks	Time Strain Remarks		
(hrs.) (µ in/in)	(hrs.) (µin/in)	(hrs.) (μin/in)		
0 20978	O gage failed	O gage failed		
0.017 gage failed	0.017 failure	0.10 failure		
0.10 failure	 			
 				
		 		
				
2	Barrana	Bassassass		
Recovery	Recovery	Recovery		
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<u> </u>				
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	SIC/3306			
Test: Creep	Test: Creep	Test: Creep		
Orient: ±45°	Orient: +45*	Orient: +45*		
Spec. No: G29-5	Spec. No: <u>G27-3</u>	Spec. No: G16-7		
Temp: 350°F(177°C)	Temp: 350°F(177°C)	Temp: 350°F(177°C)		
Stress: 1.59 ksi 20 % ult.	Stress: 1.59 wai 20 % ult.	Stress 1.59 kgi 20% ult.		
Elap. Accum.	Elap. Accum.	Elap. Accum.		
Time Strain Remarks	Time Strain Remarks	Time Strain Remarks		
(hrs.) (μ in/in)	(hrs.) (µin/in)	(hrs.) (µin/in)		
0 17447	0 886	0 8428		
0.017 23304	0.017 927	0.017 11189		
0.05 gage falled	0.10 968	0.10 14202		
517 no failure	0.25 1010	0.25 17596		
	0.50 1045	0.50 19992		
	1 1105	1 23225		
	2 1194	2 game failed 517 no failure		
	3 1743 3.5 failure	317 NO TATAGE		
	3.5 121104			
				
Recovery	Recovery	Recovery		
	-			
		I		

siC/5506

				sic/550					
, -	500 Hr. Cr	eep		500 Hr.	Creep	, –	Test: 500 Hr. Creep		
Orient	. <u>+</u> 45°		Orient: ±45°			Orient: +45°			
Spec. N	lo: G12-8		Spec.	No: G16-6		Spec. No: G30-1			
Temp:	350°F(17	7°C)	Temp:	350°F(.77°C)	Temp	350°F(177	*C)	
Stress	: 1.19 ks	i_15 % ult.	Stress	1.19	15 t ult.	Stress	1.19 ksi	15% ult.	
Elap. Time	Accum. Strain	Remarks	Elap. Time				Accum. Strain	Remarks	
	(µ in/in) 11003		(ATS.)	gage fo		(DFS.)	(µin/in) 13259		
0 017			503	no fai		0.017	14420		
0.017	12688		203	NO EAL.	urs	0.10			
0.10	14705					0.10		474	
0.25	17316 25343					503	qaqe fa no fail		
7.72	gage fa	iled					A70 202.		
503	no fail								
								~	
					.,				
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			-						
	Recovery			Recovery			Recovery		
<u> </u>									

				\$10/550				
Test:_	Creep		Test:	Creep		Test:	Creep	
1	0°/+45°/		Orien	0°/±45°,	/90°	Orien	: 0*/+45*/	/90°
Spec. I	lo: G32-5		Spec. No: 644-2			Spec. No: G41-2		
Temp:	72°F{22	*c)	Temp	72°F (22°	<u>'C)</u>	Temp	72°F(2	}
Stress	: 83.48 ks	<u>i 70 % uit.</u>	Stress	83.48 145	i_70 * ult.	Stress	83,48 kg	70 t ult.
Elap.	Accum.		Elap.	Accum.		Elap.	Accum.	
Time	Strain	Remarks	Time	Strain	Remarks	Time	Strain	Remarks
(hrs.)			(hrs.)	(Pin/in)		(hrs.)	(µin/in)	
0	4580		0	4376		0	4429	
0.617	4589		0.017	4386		0.017	4438	
0.10	4599		0.10	.394		0.10	4447	
0.25	4607		0.25	4397		0.25	4454	
0.50	4611		0.50	4402		0.50	4459	
1	4617		1	4406		1	4463	
2	4621		3	4413		3	4475	
4	4633		4	4437		4	4505	
5	4635		5	4440		5	4505	
6	4637		6	4444		6	4510	
7	4643		. 29	4457		29	4528	
24	4651		148	4461		148	4536	
25	4655		317	4462		317	4541	
26	4651		436	4457		436	4536	
28	4652		507	4468		507	4549	
29	4646							
48	4650							
125	4676							
222	4702							
341	4705							
390	4731							
509	4730							
				<u> </u>				
				<u> </u>	<u> </u>			
	Recovery			Recovery			Recovery	
0	168	Load off	9	120	Load off	0	340	Lord off
1	136		1-1	94	<u> </u>	<u> </u>	304	
2	130		2	88	 	2	298	
Ll	· · · · · · · · · · · · · · · · · · ·		3	85	<u></u>	3	292	L

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Test	Creep	1	Test:	Cree	<u> </u>	Test	Test: Creep		
	0°/+45°/	an o			·	-	Orient: 0*/+45*/90*		
		50	Orient: 0°/+45°/90°			ì	i		
Spec. N	lo: G33-4		Spec.	No: G33-6	3	Spec.	Spec. No: <u>G43-4</u>		
Temp:	72°F(32	°C)	Temp:	72°F(2	?*C)	Temp	72°F(2	?*C)	
Stress	71.55 ks	i 60 % ult.	Stress	71.55 ks	60 t ult.	Stress	71.55 ks	60 t ult.	
Elap.	Accum.		Elap.	Accum.		Elap.			
Time	Strain	Remarks	Time	Strain	Remarks	Time	Strain	Remarks	
(hrs.)			(hrs.)			(hrs.)			
<u> </u>	3485		0	3870		0	gage fa	iled	
0.017	3493		0.017	3894		506	no fai	nia	
0.10	3499		0.10	3902					
0.33	3503		0.33	3910					
0.50	3511		0.50	3917			<u> </u>		
1	3519		1	3923					
2	3520		- 3	3928					
3	3519		1-3	3927					
24	3539		24	3954				<u> </u>	
165	3556		165	3971				ļ	
245	3556		245	3978					
433	3567		433	3983			ļ		
530	3567 .		530	3992			ļ	<u> </u>	
				 					
							 		
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		 					1		
							1	 	
						1			
	Recover	У		Recovery	*		Recovery	•	
Q	-125	Load off	0	130	Load off	1			
1	-149		1	105					

				210/3300					
	Creep			Cree			Cree		
Orient	0°/ <u>+45</u> °/	90,	Orient	: 0°/+45°,	/90°	Orient	Orient: 0°/+45°/90°		
Spec. N	io: <u>G32</u> -	7	Spec. No: 634-6			Spec.	Spec. No: 639-9		
Temp:	72°F(22	<u>"C)</u>	Temp:	72°F(22°C	C)	Temp	72°F(22°	<u>'c)</u>	
Stress	59.63 kts	<u>i 50% ult.</u>	Stress:	59.63ks	i_50% ult.	Stress	59,63 kg	. 50 ° ult.	
Elap. Time	Accum. Strain	Remarks	Elap. Time	Accum. Strain	Remarks	Elap.	Accum. Strain	Remarks	
	(µin/in)	1 1	(hrs.)		•	(hrs.)	(µin/in)	Remarks	
0	3127		0	2543		0	3327		
0.017	3135		0.017	2545		0.017	3339		
0.10	3139		0.10	2552		0.10	3347		
0.25	3139			2554 2554			3347		
0.25	3143 3145	i	0.25		i	0.50	3356 3360		
1	3148		1	2558 2558		1 2	3364		
3	3150		3	2562		24	3387		
4	3152		4	2560		144	3403		
5	3155		5	2560		291	3395		
95	3181		95	2587		388	3404		
144	3178		144	2580		524	3405		
244	3187		244	2613					
411	3174		411	2623	1				
508	3178		508	2634					
						 			
									
						↓ 			
					ļ	 	<u> </u>	 	
		ļ <u></u>		-		 		 	
					<u> </u>	 			
					-	┥		 	
 	B	<u> </u>		Recovery	<u> </u>	┨ ┠━━━	Recovery	<u> </u>	
	Recover	-				 		,	
0	8	Load off	1	57 <u>1</u>	Load off	0.5	61	Load off	
	 	 		1 403	1	1.0	44		
	 	 		 	 	1	1		
	<u> </u>	1	J 1	<u> </u>	 				

1、そのからのから、これのはまといろというとうのではなる方を含まるははははははないのである。

Test:	Creep		Test:	Creep		Test:	.Creep	
,	. 0°/ <u>+</u> 45°/9	0*	} -	: 0°/+45°/	′90°		: 0°/+45	°/90 °
1	io: G32-2		ļ	No: 640-		j	No: <u>643</u> -	
1	260°F(1		Temp: 260°F(127°C)			1		
Temp:	700 -E (T	27.67	remp:	260 7 (1.	: / · (.)	1	260°F	1
Stress	82.04 ks	i 70 % ult.	Stress: 82.04 ksi 70 % ult.			Stress	82.04 ks	70 tult.
Elap.	Accum.		Elap.	Accum.		Elap.	Accum,	
Time	Strain	Remarks	Time	Strain	Remarks	Time	Strain	Remarks
	(# in/in)		(hrs.)				(µin/in)	
0	4646		0	4413		0	gage fa	
0.017	4665		0.017	4439		503	no fail	ure
0.10	4680		0.10	4450				
0.25	4683		0.25	4461				
0.50	4683		0.50	4454				
1	4683			4466				
5	4683		3	4511		-		
4	4687		4	4521				
55	4687		5	453)				
6	4688		6	4539				
1 2	4686		28	4586	····			
68	4538		77	4621				
122	4485		147	4654				
244	4431		217	4660				<u> </u>
405	4387		315	4669			······································	
500	4391		478	4729				
			503	4726				
		<u> </u>						
-								
-		<u> </u>						
			-		ļ			
								
								
	Recover	· ·		Recovery	L		Recovery	
0	-15:2	Load off	0	297	Load off			
0.5	-240		1	6)				
1	-283		3	32				
5	-301							1
3	-310		·				^	·

			Test:							
	Test: Creep Orient: 0°/ <u>+</u> 45°/90°					Test:	Creep			
ŧ			i	0*/+45		Orien	Orient: 0°/+45°/90°			
!	lo: <u>640-</u> 5		Spec. 1	No: G41-6	3	Spec.	No: G36-9	}		
Temp:	260°F(12	7°C)	Temp:	260°F(127°C)	Temp: 260°F(127°C		27°C)		
Stress	Stress: 70.32 ksi 60% ult.			70.32	60% ult.	Stres	70.32 15	60 % ult.		
Elap.	Elap. Accum.			Accum.	_	Elap.	Accum.			
Time	Strain	Remarks	Time	Strain	Remarks	Time	Strain	Remarks		
(hrs.)	(# in/in)		(hrs.)	(Pin/in)		(hrs.)	(µin/in)			
0	gage fa		0	3769		0	Failed on	loading		
521	no fail	nis	0.017	3785						
			0.10	3792						
			0,25	3795						
			0.50	3804						
			1	3806						
			4	3824						
			5	3825						
			6	3830						
			28	3866						
			99	3913		<u> </u>				
L			195	3949						
			231	gage fa	iled					
			521	no fail	UTe	 				
						 				
				_		 				
								<u> </u>		
			<u> </u>							
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					<u> </u>			 		
					-					
	Recovery			Recovery			Recovery			

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Test:	Creep		Test:	Cree	,	Test:	Craep		
	: 0°/ <u>+</u> 45°/	90.	-	:: 0°/ <u>+</u> 45°/9		Orient: 0°/+45°/90°			
	o: G33-9		1	No: G35-3		1	Spec. No: G39-5		
_	emp: 260°F(127°C)			260°F()	27°C)		Temp: 260°F(127°C)		
		i 50 % ult.			50 % ult.		58.60 ksi		
		30.00			30.			30 4 020	
Elap. Time	Accum. Strain	Remarks	Elap. Time	Accum. Strain	Remarks	Elap. Time	Strain	Remarks	
	(µin/in)		(hrs.)	(Pin/in)		(hrs.)	(µin/in)		
0	3133		0	3207		0	3236		
0.017	3149		0.017	3211		0.017	3249		
0.10	3146		0.10	3207		0.10	3272		
0.25	3173		0.25	3238		0.25	3291		
0.50	3177		0.50	3246		0.50	3304		
1	3182	 	<u> </u>	3255		1	3309		
1.5	3188		1.5	3261		2	3326		
3.	3193	ļ	3	3270		3	3335		
4	3201		4	3275		69	3391		
5	3205		5	3291		166	3417		
6	3205		6	3294		234	3434		
28	3226		28	3328		330	3455		
78	3250		78	3354		399	3469		
144	3263		144	3370		452	3476	·	
241	3276		241	3383		500	3485		
309	3282		309	3393					
406	3296		406	3400					
475	3305		475	3424					
500	3 3 0 5		500	3433		-	<u> </u>		
		}					_		
		-		 		-			
				 					
				 					
		 			 				
		 							
Recovery			Recovery			Recovery			
0	157	Load off	Û	264	Load off	Û	279	Load off	
1	113		1	187		0.5	221		
3	104		3	164		1	206		
						2	192		
						3	183		

これにはなければなるないのでは、これのとなるないのでは、ないでは、ないでは、これは、これはないできないできませんできない。

		\$1C/5506					
Test: Creep		ST:	Creep		Test:	Creep	
Orient: 0*/+45*/9	1 1	Orient: 0°/+45°/90°			Orient: 0°/+45°/90°		
Spec. No: G35-5	Spe	Spec. No: G35-8			Spec.	No: G36-	5
Temp: 350*P()	177°C) Ter	mp:	350°F(17	/7 ° C)	Temp	350°F(1	177°C)
Stress: 60.41 ks	70 % ult. Str	ME:	60.411-5	70 ult.	Stress	60.41 kg	<u>70</u> tult.
Elap. Accum.	Ela	- 1	Accum.	-	Elap.		
1 1	Remarks Tin		Strain	Remarks	Time	Strain	Remarks
(hrs.) (µ in/in) gage fai	(hz	_	(µin/in)		(hrs.)		
The second secon			3440		0	failed on	loading
504 no fail			3543				
 		10	3611				
 		25	3641				
		50	3650				
			3662				
		_	3697				
			3715				
	5	_	3760				
			3770			7	
		_	3782				
			3862				
	104	- 7	3938				
	264		3979		ļ		
	367		4056				
	486		4107				
	504		4114			,	
 							
					-	-	
		-					
		\dashv		-	-		
	 	-			-		
		-					
							
		\dashv					
		-					
Recovery		1	Recovery			Recovery	
	0		507	Load off			
	1		332				
	2		306				
	4		275				

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HyE 2034D									
Test: Creep			Test: Creep			Test: Creep			
Orient: +45°			Orient: +45°			Orient: +45°			
Spec. No: H18-5			Spec. No: H15-2			Spec. No: H16-8			
Temp:	Temp: 72°F(22°C)			Temp: 72°P(22°C)			Temp: 72°F(22°C)		
Stress	: 8.68 ks	i 80% ult.	Stream	8.68 148	i ₈₀ i ult.	Stress	8.68 kg	80 % ult.	
Elap. Time (hrs.)	Accum. Strain (µ in/in)	Remarks	Elap. Time (hrs.)	Accum. Strain (Fin/in)	Remarks	Elap. Time (hrs.)	Accum. Strain (µin/in)	Remarks	
0	3390		0	2896		0	3030		
0.017	3464		0.017	2970		0.017	3097		
0.10	3550		0.10	3032		0.10	3150		
0.25	3657		0.25	3121		0.25	3239		
0.50	3714		0.50	3167		0.50	3282		
1	3775		1	3211		I	3328		
2	3825		2	3242		2	3353		
3	3869		3	3274		3	3384		
5	3925		5	3320		5	3431		
6	3942		6	3330		6	3444		
7	3963		7	3344		7	3458		
8	3980		8	3355		8	3468		
9 6	4310		96	3592		96	3722		
175	4440		175	3686		175	3814		
270	4617		270	3842		270	3972		
344	4669	<u> </u>	344	3857		344	3991		
434	4714		434	3882	<u> </u>	434	4023		
530	4802		530	3963		530	4098		
Recovery				Recovery		Recovery			
٥	1392	Load off	0	1038	Load off	û	1080	Load off	
1	840		1	602	ļ		626		
	737	ļ		52B	<u> </u>		545		

HyE 2034D

				HyE 203	4U			
Test:	Creep		Test:	Creep		Test:	Creer	
Orient: ±45°			Orient: +45*			Orient: +45*		
Spec. No: 416-7 Temp: 72°F(22°C)			Spec. No: H18-4 Temp: 72°F(22°C)			Spec.	No: H19-7	سنب ۳ - سنتی
						Temp: 72°F(22°C)		
Stress	. 7.30 kg	i 70% ult.	Stress	7.30 ks	70 t ult.	Stress	7.30 141	70 % Wit.
Elap. Time	Accum. Strain (µ in/in)	Remarks	Elap. Time (hrs.)	Accum. Strain (Hin/in)	Remarks	Elap. Time (hrs.)	Accum. Strain (µin/in)	Remarks
0	2841		0	2938		0	3010	
0.017	2886		0.017	2982		0.017	3093	
0.10	2957		0.10	3049		0.10	3182	
0.25			0.25					
	3015			3096		0.25	3238	
0.50	3060 3101		0.50	3135		0.50	3289	
2	3150		1	3170		1	3330	
			2	3210		-3	3381	
3	3178		1 2	3230		3	3404	
21	3368		21	3395		21	3604	
120	3659		120	3605		120	3859	
283 361	3832		283	3749		283	4027	
456	3972 3914		361	3874		361	4157	
504			456	3808		456	4102	
304	3912		504	3808		504	4102	
								
						-		
						-		
			-					
		*		 				
						-		
				 				
								
				<u> </u>			***************************************	
				1				
Recovery			Recovery			Recovery		
û	961	Load off	0	856	Load off	0	943	Load off
	688		1	619		1	715	
2	660		2	596		2	679	
3	645		3	578		3	661	

HyE 2034D Test: Test: Test: Creep Creen +45° Orient: Orient: +45° Orient: +45° Spec. No:_ Spec. No: 114-7 H12-9 Spec. No: H19-6 Temp: 72°F(22°C) 72°F (22°C) 72°F(22°C) Temp: Temp:_ Stress: 5.43 ksi 50% ult. Stress: 5.43 ksi 50% ult. Stress 5.43 ksi 50 % wit. Elep. Elap. Elap. Accum Accum. Accum. Time Strain Remarks Time Strain Remarks Time Strain Remarks (hrs.) (# in/in) (hrs.) (Hin/in) (hrs.) (µin/in) 1970 0 2260 1983 0.017 2055 0.017 2321 0.017 2037 0.10 2100 0.10 2362 0.10 2068 0.25 2130 0.25 2396 0.25 2098 0.50 2152 0.50 2419 2177 2445 4322 2492 2175 2505 2243 2513 2192 2254 6 6 2523 2201 6 28 2344 28 2615 28 2279 77 2425 77 2701 3349 2759 148 148 2479 2398 216 2506 216 2785 216 2421 2545 2459 2609 478 2899 473 2520 504 2608 504 2901 504 2522 Recovery Recovery Recovery Load off Load off 597 667 load off 550 461 503 385 431 459 359

HyE 2034D

Test:_							
Orient: ±45°							
Spec. 1	Spec. No: H10-6						
Temp:	Temp: 260°F(127°C)						
Stress	Stress: 4.70 ksi 50% ult.						
Elap.	Accum.						
Time		Remarks					
(hrs.)	(# in/in)						
0	1945						
0.017	1993						
0.10	2046						
0.25	2084						
0.50	2120						
1	2162						
2	2213						
3	2238						
4	2263						
5	2287						
6	2301						
7	2320						
24	2441						
79	2725						
198	3040						
312	3228						
414	3337						
504	3431						
Recovery							
0	1605	Load off					
3	1426						
2	1407						
4.5	1367						

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Test: Creep						
Orient	Orient: ±45°					
Spec. No: Hil-10						
	Temp: 260°F(127°C)					
Stress: 4.70 ksi 50 % ult.						
Elap.						
Time	Strain	Remarks				
	(Fin/in)					
0	1761					
0.017	1779					
0.10	1815					
0.25	1845					
0.50	1876					
1	1909					
2	1950					
3	1973					
4	1991					
5	2004					
6	2018					
7	2029					
24	2126					
79	2384					
198	2596					
312	2730					
414	2805					
504	2884					
		<u> </u>				
Recovery						
0	1099	Load off				
1	965					
2	950					
4.5	915	L				

Ī	Test: Creep							
	Orient: +45°							
	Spec. No: H16-6							
	Temp:	Temp: 260°F(127°C)						
	Stress	Stress 4,70 ksi50 % ult.						
7	Elap.							
	Time	Strain	Remarks					
_	(hrs.)	(µin/in)						
]	0	1750						
	0.017	1829						
	0.10	1880						
	0.25	1918						
	0.50	1957						
7	1	1998						
	2	2049						
٦	3	2076						
	4	2104						
]	5	2122						
7	6	2132						
	7	2149						
]	24	2271						
]	79	2549						
]	198	2886						
]	312	3102						
]	414	3279						
]	504	3397						
		Recovery						
	0	1656	Load off					
	1	1510						
]	2	1501						
	4.5	1457						

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Test: Creep	Test:	Creep	t	ilest:	Creep	
Orient: ±45°	Orient: +45°			Orient: <u>+45</u> *		
	į.			I I		
Spec. No: H14-8	1	No: H15+6		Spec. No: H18-6		
Temp: 260°F(127°C)	Temp: 260°F(127°C)			Temp: 260°F(127°C)		
Stress: 6.57 ksi 70 % ult.	Stress:	6.57 ks	<u>70</u> ult.	Stress_6.57_ksi_70 * ult		
Elsp. Accum.	Elap.	Accura.		Elap.	Accum.	
Time Strain Remarks	Time	Strain	Remarks	Time		Remarks
(brs.) (µ in/in)	(hrs.)	(Pin/in)		(hrs.)	(µin/in)	
0 2826	0	2956		0	3387	
0.017 2946	0.017	2977		0.017	3624	
0.10 3075	0.10	3039		0.10	3778	
0.25 3250	0.25	3103		0.25	3918	
0,50 3262	0.50	3157		0.50	4049	
1 3256		3207			4197	
2 3281	2	3272		2	4379	
4 3332	4	3356		4	4595	
5 3340	5	3381		5	4679	
5 3364	6	3399		5	4765	
7 3377		3416		7	4844	
24 3544	24	3€03		69	7560	
143 4257	143	4089		122	11054	<u> </u>
246 5137	246	4468		221	Failu	re
365 8697	356	4820			A	
414 gage failed	434	4969				
527 no failure	527	5343				
			<u> </u>			
						
						
	<u> </u>					
	ļ	ļ				
			ļ	 		ļ
		<u> </u>				
		ļ	ļ			
			<u></u>		<u> </u>	<u></u>
Recovery		Recovery	·		Recovery	·
		2417	Load off			<u> </u>
	0.5	2119				
	1	2052	 		ļ	
<u> </u>	2 3	1977	<u> </u>	<u> </u>	L	<u>L </u>

HVE 20340

				HyE 2034	D				
Test:	Creep		Test:	Creep		Test:	Creen		
Orient	+45*		Orient: +45°			Orient: ±45°			
Spec. N	To: H12-8		Spec. 1	Spec. No: H19-5		Spec. No: H16-5			
Temp:	260°F(12	7°C)	Temp: 260°F(127°C)		Temp: 260*P(127*C)		7°C)		
Stress	Stress: 5.63 ksi 60% uit.		Stress	5.63 ks	60 tult.	Stres	5.63 kwi	. 60% ult.	
Elap.	Accum. Strain	Remarks	Elap.	Accum.	Remarks	Elap. Time	Accum. Strain	Remarks	
Time	(# in/in)	1	1	(Pin/in)		(hrs.)		Kemerks	
0	2133		0	2466		0	2437		
0.017	2257		0.017	2506		0.017	2448		
0.10	2345			2553		0.10			
0.25	2411		0.10	2595			2567		
0.25	2469		0.25	2595 2634		0.25	2631		
						0.50	2696	-	
2	2532 2616		2	2684 2752		2	2765 2859		
				2818					
<u>4</u> 5	2709 2739		5	2841		5	2861 7993		
6	2775		6_	2860		6	3027		
7	2796		7	2877		7	3054		
24	3021		24	3045		24	3310		
143	3552		143	3336		143	3858		
246	3885		246	3493		246	4186		
365	4208		365	3662		365	4525		
414	4355		414	3727		414	4655		
527	4666		527	3872		527	4959		
						1			
	Recover			Recovery		 	Recovery	}	
	VACOASI	,		<u> </u>		 			
0	2403	Load off		1493	Load off	<u></u>	2517	Load off	
0.5	2236		0.5	1299		0.5	2309	-	
1	2188	ļ	1	1251	 	1	2259	 	
2	21,34	<u> </u>]	1207	L	ــــــا ا	2204		
3	2096		3	1189		3	2171		

HyE 2034D

Test:	Creep		Test: Creep			Test: Creep			
	+45°		Orient: +45°			-			
1	io: H10-7		1	No: H12-10	The second state of the second	Orient: <u>+45°</u> Spec. No: <u>814-9</u>			
1	350°F(1	.77°C)	ł	350°F(1					
•			1			Temp: 350°F(177°C) Stress 5.25 ksi 60° ult			
Stress: 5.25 ksi 60 % ult.				60 % ult.	-		60 WIE.		
Elap.				Elap. Accum.			Elap. Accum.		
Time (hrs.)	Strain (µ in/in)	Remarks	1 .	Strain (Pin/in)	Remarks	Time	Strain (µin/in)	Remarks	
0	2901		(11.8+)	3203		0			
0.017	3088		0.017	3361		0.017	3953 5028		
0.10	3463		0.10	3716		0.10			
0.25	3798		0.25	4155		0.10	9087		
0.50	4034		0.50	4548		0.25	10676		
1	4411	-	1	5123		1	11506		
3	5381		3	6313		3.5	gage fa	ileā	
4	5780		4	6936		119			
5	6131	to a continue to the continue	5	7549					
6 .	6482		6	8195					
24	gage	failed	24	22391					
114		failure	114		failure				
					المستودين المالية في المالية				
	-						-		
	ومياوي بايدان جيايس سيد بمرايات								
									
									
-									
-			- painting part & sure						
			-		 				
	Recover	у	Contract Con	Recovery			Recovery		
			}						

HyE 2034D

Test:	Creep		Test:	Спвер		Test:	Creen		
Orient	±45°		Orient	+45°		Orient: +45°			
}	o: H10-9		1	No: H17-10		Spec. No: H19-8			
Temp:	350° r (1	.77°C)	1	Temp: 350°F(177°C)			Temp: 350*#(177°C)		
ł		d so ult.	1		i_50 % wlt.	1	Strees 4.38 kgi 50% ult		
	Accum.	, white best		Accum.			Accum.		
Time	Strain (µ in/in)	Remarks	Time	Strain (#in/in)	Remarks	Time		Remarks	
0	3521		o	1871		0	3617		
0.017	3956		0.017	2019		0.017	3719		
0.13	5956		0.10	2233		0.10	3980		
0.25	5855		0.25	2421		0.25	4135		
0.50	6653		0.50	2622		0.50	4299		
l	7555		1	2892		1	4487		
3	9127		3	3535		3	4871		
4	9557		4	3763		4	4989		
5	9868		5	3941		5	5082		
6	10201		6	4154		6	5185		
24	12524		24	6106		24	6082		
95	17863		95	9466		95	7804		
. 91	qaqe t	ailed	191	11573		191	9010		
502	no fai	lure	263	13139		263	9649		
			365	gage f	ailed	502	11497		
	(4.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1		502	no fai	ure				
									
					<u> </u>				
		 			}				
	-		<u> </u>	<u> </u>	 	-		<u> </u>	
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		<u> </u>							
	<u> </u>				the second resident description	-			
	Recover	У		Recovery		 	Racovery	,	
		ļ				0	9792	Load off	
		 			_	0.5	9586		
 		 		 	 	1	9521		
				<u> </u>	<u> </u>	1 - 3	9412 >333	J	

人名英格兰姓氏 经营业 医骨髓 医甲基甲状腺 医甲基氏性神经炎 医神经神经病 医神经病病

HYE 2034D

		·	, <u>, , , , , , , , , , , , , , , , , , </u>	HYE 2034	_	,			
	Creep		Test: Creep			Test: Creap			
Orient	Orient: +45°			Orient: ±45°			Orient: +45*		
Spec. 1	Spec. No: H14-6			Spec. No: 817-8			Spec. No: E18-3		
Temy:	350°F(17	7°C)	Temp:	350°F(1	77°C)	Temp	350°F(17	7°C)	
Stress	: 3.50 ks	1 40 % ult.	Stress	3.50	40% ult.	Stress	3.50 150	40 t ult.	
Elap.	Ассит.		Elap.	Accum.		Elap.			
Time	Strain	Remarks	Time	Strain	Remarks	Time		Remarks	
	(Fin/in)	 	(b.rs.)			(hrs.)	(uin/in)		
0	2031		0	1459		0	1681		
0.017	2196		0.017	1541		0.017	1797		
0.10	2985		0.10	1820		0.10	2446		
0.25	4697		0.25	1962		0.25	2952		
0.50	5761		0.50	2112		0.50	3296		
1	7579	1	1	2416		1	3890		
3	7848		3	2953		3	5126		
4	8286		4	3301		4	12362		
5	8886		5	3542		5	13097		
6	9282		6	3749		6	13435		
24	12562		24	6366		24	16255		
118	gage	ailed	118	10777		118	20786		
502	no fa	lure	220	13787		220	gage	ailed	
			317	18164		502	no fai		
			454	gage fa	iled				
			502	no fail					
									
	 								
	Recover	y		Recovery			Recovery		
			-						
	 							1	
	 						1		
			· ·		}	, I			

HyE 2034D

				HyB 2034D					
, –	Creep		Test:	Creep		Test:	Creen		
Orient	Orient: 0/+45/90*			Orient: 0/+45/90*			Orient: 0/+45/90°		
Spec- N	lo: H24-7		Spec. 1	No: H24-8		Spec. No: H28-5			
Temp:	Temp: 72*P(22*C)			Temp: 72*P(22*C)			Temp: 72°F(22°C)		
Stress	Stress: 60.66 ksi80 t ult.		Street: 60.66 tai 80 % uit.		Stres	5 60.66 kg	80 tuit.		
Elap. Time	Accum. Strain	Remarks	Elap. Time		Remarks	Elap. Time	Accum. Strain	Remarks	
ł - 1	(µ in/in)	1		(Pin/in)		(brs.)			
0	2165		0	2031		0	2031		
0.017	2169		0.017	2040		0.017	2034		
0.10	2171		0.10	2051		0.10	2046		
0.25	2178		0.25	2052		0.25	2049		
0.50	2176		0.50	2057		0.50	2051		
1	2176		1	2057		1	2051		
3	2180		3	2047		3	2044		
4	2166		4	2031		4	2031		
5	2149		5	2022		5	2022		
6	2150		6	2031		6	2030		
24	2170		24	2043		24	2049		
94	2185		94	1984		94	1991		
191,	2195		191	2072		191	2075		
226	lost gage		226	lost gage		226	lost gage		
504	no failur	e	504	no failure		504	no failure		
								24.7	
							ļ		
	· · · · · · · · · · · · · · · · · · ·	ļl							
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	9			P	1	 	Recovery	-	
	Recover	7		Recovery			Recovery		
		 							
		 						-	
		 			 		-		
		L		1	<u> </u>		<u> </u>	<u> </u>	

Test: Creep Orient: 0/+45/90* Spec. No: H24-2 Temp: 72°F(22°C) Stress: 53.07 ksi 76 % ult. Elap. Accum. Time Strain Remarks (# in/in) (hrs.) 0.017 0.10 0.50 Recovery Load off 0.5

HyE 2034D											
Test: Creep											
Orient: 0/+45/90°											
Spec.	Spec. No: H20-1										
Temp:	72°F(22	°C1									
Stress	53.07 kg	70% ult.									
Elap.	Elap. Accum.										
		Remarks									
(hrs.)	(#in/in)										
0	1798										
0.017	1799										
0.10	1802										
0.50	1797										
1	1797										
2	1794										
44	1799										
5	1787										
7	1788										
24	1800										
78	1846										
143	1800										
240	1858										
31.1	1858										
434	1822										
503	1825										
	8										
	Recovery	,									
	59	Load off									
0.5	55										
1	52										
3	61										

Test:	Creep										
Orient	5 4 45 45	0*									
Spec.	No: H28-4										
1	72°F(22°C	1									
}	Stress 53.07 bi 70 % ult.										
Elap.	Accum.	ه بالنظ									
Time	Strain	Remarks									
(hrs.)	$(\mu in/in)$										
0	1771										
0.017	1774										
0.10	1775										
0.50	1772										
1	1769										
2	1768										
4	1762										
5	1759										
7	1763										
24	1768										
78	1816										
143	1768										
240	1847										
311	1845										
434	1818										
503	1817										
	Recovery										
0	50	Load off									
0.5	50										
1	49										
3	47										

HyE 2034D Creep

Orient: 0/±45/90°

Test:

Test:	Creep									
Orient: 0/+45/90*										
Spec. No: H21-1										
Temp: 72°F(22°C)										
Stress: 45.49 ksi 60 t ult.										
	Accum.									
		Remarks								
	(µ in/in)									
٥	1711									
0.017	1711.									
0.10	1717									
0.25	1716									
0.50	1717									
1	1717									
2	1718									
3	1718									
5	1716									
6	1712									
24	1691									
96	1745									
198	1730									
264	1747									
361	1730									
432										
	1730									
504	1702									
	-									
	Recover									
0	-4	Load off								
1	-16									
2	-16]								
i	1									

Spec. No: 821-2								
Temp: 72°F(22°C)								
Stress:	45.49 149	60 % ult.						
Elap.	Accum.							
Time	Strain	Remarks						
(hrs.)	(Fin/in)							
0	1579							
0.017	1581							
0.10	1581							
0.25	158)							
0.50	1582							
11	1581							
2	1584							
3	1583							
5	1580							
6	1577							
24	1560							
96	1602							
198	1587							
264	1604							
351	1582							
432	1581							
504	1558							
	Recovery							
0	- ' 6	Load off.						
1	-20							
- 2	-21							

Test: Creen									
Orient: 0/+45/90*									
Spec. No: H28-6									
Temp: 72°F(22°C)									
Stress 45.49 ksi 60 % ult.									
Elap.	Accum.								
Time	Strain	Remarks							
(hrs.)	(µin/in)								
O	1500								
0.017	1500								
0.10	1500								
0.25	1499								
0.50	1500								
1	1500								
2	1500								
3	1499								
5	1496								
6	1496								
24	1476								
96	1520								
198	1502								
264	1520								
361	1502								
432	1500	.,							
504	1474								
	Recovery								
-9	<u> </u>	Load off							
-1	-21								
2	-23								
	r								

				HyE 20	34D			
	Creep		Test:	Creep		Test:	Creep	
Orient: 0/+45/90*			Orient: 0/+45/90*			Orient: 0/+45/90*		
	io: 820-2		Spec. I	No: H24-6		Spec.	No: нзз-	-8
Temp:	Temp: 260°F(127°C)			260°P()	27°C)	Temp: 260°F(127°C)		
Stress	: 60.0 ks	1 72 tult.	Stress	60.0 ks	172 ult.	Stress	60.0 ks	72 t ult.
Elzp. Time	Accum. Strain (µ in/in)	Remarks	Elap. Time (hrs.)	Accum. Strain	Remarks	Elap. Time (hrs.)	Accum. Strain	Remarks
0	2250		0	(#in/in) 1970	tab slipped	0	(µin/in) 1950	
0.017	2241		0.017	1962	LaD SIIPARU	0.017	1950	
0.10	2195		0.10	1962		0.10	1946	
0.25	2195		0.25	2036		0.10	2022	
0.50	2249		0.50	2051		0.50	2022	
1	2241		1	2051		1	2024	
2	2231		2	2045		2	2022	
4	2231		4	2042		4	2021	
5	2224		5	2042		5	2024	
6	2224		6	2037		6	2022	
7	2223		7	2033		7	2023	
21	failur		21	failu	ce	21	failu	e
بوالمسووا								
								ļ
			 					
								
							<u> </u>	
								
					 			
	Recover	, ————		Recovery	<u> </u>		Recovery	<u> </u>
			 		T			
								<u> </u>
<u> </u>		 						
	 	 			T			

HyE 20340

Test: Creep Orient: 0/485/90* Spec. No: B27-3 Temp: 260*F(127*C) Strains: 50.0 ksi 60* ult. Elap. Accum. Time Strain (hrs.) (µin/in) O 1748 0.017 1754 0.10 1753 0.25 1749 0.50 1743 1 1725 3 177' 4 1702 5 1700 6 1699 24 1694 95 1696 24 1694 95 1696 24 1694 95 1696 24 1694 95 1696 24 1694 95 1696 25 1700 6 1699 334 1700 4170	нув 20340									
Spec. No: H27-3 Spec. No: H28-2 Temp: 260°F(127°C) Stress: 50.0 ksi 60\$ ult. Stress: 50.0 ksi 60\$ ult. Stress: 50.0 ksi 60\$ ult. Elap. Accum. Time Strain (μ in/in) O 1748 O gage failed O 1653 O 1753 O 1753 O 1753 O 1753 O 1743 O 1753 O 1744 O 1755 O 1755 O 1744 O 1755 O 1744 O 1755 O 1744 O 1755 O 1745 O 1755 O 1745 O 1755 O 17	Test:_	Creep		Test:	Creep		Test:	Creez		
Temp: 260°F(127°C) Stress: 50.0 ksi 60° ult. Elap. Accum. (h in/in) Co 1748 0.017 1754 0.019 1749 0.10 1753 0.25 1749 0.50 1743 1 1725 3 176° 4 1702 5 1700 6 1698 24 1694 95 1696 169 1696 169 1696 169 1696 169 1696 169 1696 169 1696 169 1696 170 170 180 1697 180 1698 1	Orient	0/+45/90	•	Orien	Orient: 0/+45/90*			Orient: 0/+45/90*		
Stress: 50.0 ksi 60* ult. Stress: 50.0 ult	Spec. N	lo: <u>H27-3</u>		Spec.	No: <u>828-</u> 2		Spec. No: 933-7			
Elap. Accum. Time Strain (hrs.) (µ in/in)	Temp:	260°F(127	*c)	Temp	260°F()	.27°C)	Temp	260°F()	.27°C)	
Time (hrs.) (μ in/in) (μ in/in) (μ in/in) (hrs.) (μ in/in) (Stress: 50.0 ksi 60% alt.		Stress	: 50.0 ks	<u> 601 ult.</u>	Stress	50.0 ksi	60 % ult.		
(hrs.) (µin/in) 0 1748 0 0 1748 0 0 1754 0 0 1754 0 0 1753 0 0 1754 0 0 1508 0 1749 0 0 1508 0 1749 0 0 1508 0 1743 0 0 1508 0 1743 0 0 1508 0 1628 0 1 1617 0 1617			Remarks			Remarks			Remarks	
0.017 1754 508 no failure 0.017 1652 0.10 1753 0.25 1749 0.25 1635 0.50 1743 1725 1 1617 3 1767 3 1606 4 1595 5 1700 5 1591 6 1698 24 1581 95 1696 95 1696 169 1696 1696 1699 263 1699 263 1539 334 1700 135 1539 334 1700 135 1528 508 1695 508 1531		(µ in/in)		(hrs.)	(Pin/in)		(hrs.)	(µin/in)		
0.10 1753 0.10 1649 0.25 1635 0.50 1743 0.50 1743 0.50 1628 1 1725 1 1 1617 3 1606 4 1702 4 1595 5 1700 5 1591 6 1586 24 1694 24 1591 95 1696 169 1528 263 1699 334 1700 343 1697 3413 1528 3508 1695 35	0	1748		0	gage f	ailed	0	1653		
0.25 1749	0.017	1754		508	no fai	lure	0.017	1652		
1743	0.10	1753					0.10	1649		
0.50 1743	0.25	1749					0.25	1635		
1 1725 1617 3 1606 4 1595 5 1700 5 1591 6 1586 95 1550 1698 95 1550 1699 1696 1699 1696 1699 1696 1699 1697 135 1539	0.50	1743								
4 1702 4 1595 5 1591 6 1586 24 1581 95 1590 169 1528 263 1599 263 1539 334 1700 413 1528 508 1531 508 1695 508 1531	1	1725								
5 1700 5 1591 6 1586 24 1581 95 1696 95 1550 169 1699 169 1528 263 1539 334 1700 135 1539	3	170*					3	1606		
6	4	1702					4	1595		
24 1694 95 1696 95 1550 169 1696 169 1528 263 1699 263 1539 334 1700 335 1539 413 1528 508 1695 508 1531 1531	5	1700					5	1591		
95	6	1698					-6	1586		
169	24	1694					24	1581		
263 1699 2334 1700 2413 1539 2413 1528 2508 1695 2508 1531 2508 1531 2508 2508 2508 2508 2508 2508 2508 2508	95	1696					95	1550		
334 1700	169	1696					169	1528		
A13 1528	263	1699					263	1539		
Solution							335	1539		
Recovery Recovery 0 -115 Load off 1 -27		<u>}</u>			<u> </u>					
0 -22 Food off 1 -27 0 0 -115 Load off 1 -113	508	1695					508	1531		
0 -22 Food off 1 -27 0 0 -115 Load off 1 -113					<u> </u>					
0 -23 Ford off 1 -27 0 0 -115 Load off 1 -113						ļ				
0 -22 Food off 1 -27 0 0 -115 Load off 1 -113				 			 			
0 -22 Food off 1 -27 0 0 -115 Load off 1 -113			<u> </u>	 		 				
0 -22 Food off 1 -27 0 0 -115 Load off 1 -113		 		┨ ├───	 	-				
0 -22 Food off 1 -27 0 0 -115 Load off 1 -113		<u> </u>	<u> </u>	 	+					
0 -22 Food off 1 -27 0 0 -115 Load off 1 -113	 				 					
0 -22 Food off 1 -27 0 0 -115 Load off 1 -113					 					
0 -22 Food off 1 -27 0 0 -115 Load off 1 -113		 	 	1	 					
0 -22 Food off 1 -27 0 0 -115 Load off 1 -113			 	1		1	1			
1 -27		Recover	Y	1	Recovery		1	Recovery		
1 -27 1 -113	9	-22	Load off		T		0	-115	Load off	
2 -24 2 -109	1	-27					1	-113		
	2	-24					2	-109		
			<u> </u>]		1	! L			

HyE 2034D Test: Creep 0/+45/90* Orient: **#20~6** Spec. No: Temp: 260°F(127°C) 40.0 km 48 % ult. Stress: Elap. Accum. Time Strain Remarks (hrs.) (# in/in) 0 1359 0.017 1366 0.10 1359 0.25 1359 0.50 1358 1351 2 1354 3 1349 6 1348 7.5 1350 24 1341 96 1341 145 1343 267 1344 361 1340 432 1342 504 1341 Recovery -7 Load off 0 1 -2 2 -4 -2

	WY 20 3-10									
-	· ·									
Orient	Orient: 0/+45/90°									
Spec. 1	Spec. No: H26-7									
Temp:	260°F(1	27°C)								
Stoness:	40.0 kg	48 4 ult.								
Elap.	Accum.									
Time	Strain	Remarks								
(hrs.)	(#in/in)									
0	1369									
0.017	1371									
0.10	1364									
0.25	1361									
0.50	1354									
1	1357									
-2	1348									
-3-	1348									
6	1340									
7.5	1340									
24	1338									
96	1314									
145	1326									
267	1315									
361	1310									
432	1312									
504	1313									
		<u> </u>								
		 								
										
										
	P	<u> </u>								
	Recovery									
0	-20	Load off								
1	-22									
2	-19	ļ								
3	-19	I								

Test:								
Orient	0/445/	90*						
Spec. No: H27-9								
Temp: 260°F(127°C)								
Stress	40.0 kgi	48 * ult.						
Elap.	Accum.							
Time	Strain	Remarks						
	(µin/in)							
0	1488							
0-017	1489							
0.10	1488							
0.25	1484							
0.50	1477							
1	1477							
2	1472							
3	1473							
6	1472							
7.5	1468							
24	1466							
96	1456							
145	1459							
267	1454							
361	1450							
432	1451							
504	1457							
	17.4							
	Recovery							
0	2	Load off						
1	-B							
2	-3							
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HyE 2034D

Test	Creep		Test:	Creep		Test:	Creep	· · · · · · · · · · · · · · · · · · ·
Orient	0/±45/90°			Orient: 0/+45/90* Orient: 0/+45/90*			ю•	
Spec. No: #2?-9			Spec. No: 827-6			Spec. No: H23-7		
Temp:	350°F(17	77°C)	Temp:	350°P(1	77°C)	1	350*F(1)	
Stress: 66.22 tsi 801 ult.				180 % ult.	1	66.22 lest		
Time	Accum. Strain	Remarks	Elap. Time		Remarks	Elap. Time		Remarks
0	(# in/in) 2565		(hrs.)			7	(µin/in)	
0.017			0	2311		0	2325	
0.10	2589		0.017	2320		0.017	2340	
	2556		0.10	2301		0.10	2351	
0.25	2589	-	0.25	2331		0.25	2351	
0.50	2589		0.50	2345		0.50	2348	
1	2596		1	2344		<u> </u>	2348	
1.5	2596		1.5	2348		1.5	2348	
6	2613			2162		6	2352	
7	2615		7	2398		7	2350	
8	2614		8	2390		8	2352	
103	2654		103	2460		103	2368	
240	2672		240	2511		240	2398	
342	2694		342	2544		342	2405	
357	failu	re	357	gage f	ailed	408	2411	
			505	no fai	ure.	505	2415	
Recovery			Recovery		Recovery			
						0	201	
						5	188	
						5	172	
			-			6	172	

HyE 2034D

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				HyE 2034				
Test:_	Creep		Test:	Creeb		Test:	Creer	
Orient	0/ <u>+</u> 45/90*		Orient: 0/+45/90°			Orient: 0/+45/90*		
Spec. No: H25-4			Spec.	Vo: <u>н</u> 26-6		Spec. No: H27-8		
Temp:	350°F(1	.77°C)	Temp	350°F(1	77°C)	Temp	350°F(17	7°C)
Stress: 57.95 tsi 70% ult.		Stress	57.95	70 1 ult.	Stress	57.95 ksi	<u>70</u> € ult.	
Elap. Time	Accum. Strain	Remarks	Elap. Time	Accum. Strain	Remarks	Elap. Time	Strain	Remarks
(hrs.)	(µ in/in)		(hrs.)			(hrs.)		
0	1996		0	1944		0	2054	
0.017	1999		0.017	1935		0.017	2064	
0.10	1996		0.10	1929		0.10	2076	
0.25	1989		0.25	1934		0.25	2076	
0.50	1988		0.50	1934		0,50	2064	
1	1988		1	1937		1	2063	
2	1984		2	1933		2	2057	
4	1971		4	1918		4	2050	
7	1962		7	1910		7	2044	
24	1952		24	1899		24	2041	
76	1951		76	1896		76	2011	
142	1953		142	1892		142	1987	المستدين المستدين
247	1975		247	1891		247	1991	
342	1982		342	1895		342	1995	
413	1992		413	1889		413	2002	
505	1 99 5		505	1891		505	200.7	
	Recover	У		Recovery			Recovery	
0	-15	Load off	0	-166	Load off	0	116	Load off
2	-24		2	~184		2	109	
4	-33		4	~184		4	106	
5	-32		5	-187	<u> </u>	5	104	<u> </u>

HyE 2034D

Test: Creep Test: Creep Test: Creep Orient: 0/+45/90* 0/<u>+4</u>5/90° Orient: Orient: 0/+45/90° Spec. No: H21-4 Spec. No:___ H23-5 Spec. No: 833-6 Temp: 350°F(177°C) Temp: 350 *F(177 *C) Temp: 350°F(177°C) Stress: 49.37 ksi 60% ult. Street: 49.37 kgi 60% tilt. Stress 49.37 ksi 60 % ult. Elap. Elap. Accum. Accum. Elap. Accum. Time Strain Remarks Time Strain Remarks Time Strain Remarks (hrs.) (# in/in) (hrs.) (Fin/in) (hrs.) (pin/in) 0 gage failed 0 1616 0 1604 503 no failure 0.017 1624 0.017 1607 0.10 1635 0.10 1600 0.25 1624 0.25 1601 0.50 1527 1598 1629 1 1604 2 1622 2 1603 1609 1595 1602 1599 1801 1603 7 1600 24 1560 24 1623 95 1483 1660 174 1451 1683 364 1.465 364 1701 431 1464 431 1698 503 1.480 503 1687 Recovery Recovery Recovery 0 -74 Load off 160 Load off 0.5 -90 ŭ.5 168 -91 3 3 159 -93 164

				V378A				
Test:_	Creap		Test:	Creep		Test:	Creep	
Orient	: <u> </u>		Orient	: <u> </u>		Orient: +45°		
Spec.	lo: 13-4		Spec. No: 14-10			Spec. No: 17-8		
Temp:	72°F (22	(°C)	Temp:	72°F(2	2°C)	Temp:	72°F(22	<u>.co</u>
Stress	; 16.93 ks	i 80 % uit.	Stress:	16.93	80% ult.	Stress	16.93 kSi	80 tult.
Elap.	Accum. Strain	Remarks		Accum. Strain	Remarks	Elap. Time	Accum. Strain	Remarks
(hrs.)		1	1 1	(#in/in)			(µin/in)	
0	8762		0	8152		0	9010	
0.017	9276		0.017	8560		0.017	9428	
0.10	9913		0.10	9137		0.10	10024	
0.25	10265		0.25	9423		0.25	10350	
0.50	10514		0.5C	9691		0.50	1059C	
1	10807		1	10065		1	10876	
2	11130		2	10372		2	11189	
3	11333		3	10564		3	11385	
5	11628		5	10741		5	11676	
7	11949		6.5	10802		?	11827	
8	11942		7.5	10995		8	11910	
21	12554		8	11031		24	12515	
73	13428		24	11807		73	13368	
144	14323		84	fallure		144	14257	
223	14850					223	14752	
413	15549					413	15413	
503	15644					503	15510	
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	Pecover	y		Recovery	1		Recovery	7
0	gage faile	d on				0	7103	load off
	unloadir					0.5	6081	
						1	5 387	ļ
						2	5067	
			_			3	4864	

V378A

(T. 2.2.1	G		Tage	VAVEV		2 7		
Test:_	Creep		Test:				Creen	
Orient			Orient: +45°		Orient: ±45°			
	lo: 15-4		Spec. No: 16-4		Spec. No: 18-4			
Temp:	72*F(22*	<u>C)</u>	Temp:	72°F(2	2°C)	1 1	72°F(22'	1
Strass: 14.90 ksi 70 % ult.		1 70 % wit.	Stress:	14.90 kg	i <u>70</u> * ult.	Stress	14.90 ksi	. 70 % uit.
Elap.	Accum		Elap.	1 - 1 1 1		Elap.	Accum.	
Time	Strain	Remarks	Time	Strain	Remarks	Time	Strain	Remarks
(hrs.)			(hrs.)	(Him/in)		(hrs.)	(µin/in)	
0	6330		0	6578		0	6744	
0.017	6728		0.017	6894		0.017	6955	
0.10	7128		0.10	7275		0.10	7341	
0.25	7300		0.25	gage fai	Led	0.25	7521	
0.50	7465		581	no fai	1	0.50	7695	
1	7650					1	7886	
2	7830					2	8080	
4	8051					4	8306	
5	8137					5	8386	
6	8200					6	8467	
7	8264					7	8481	
24	8752					24	90/3	
73	9616					73	9944	
146	10965					146	11342	
240	11517					240	11872	
312	11838					31.2	12189	
581	12379					581	12717	
					,			
			-					
	Recovery		Recovery			Recovery		
0	5957	load off				0	6125	load off
1	4527						4559	
						 		
				1]]	L	

V378A Test: Test: Test: Creep Creep ±45° +45* <u>+45</u>* Orient: Orient: Orienta Spec. No: 13-7 Spec. No: 16-3 Spec. No: 18-1 Temp: 72*F(22*C) Temp: 72*P(22*C) Temp: 72°F(22°C) Stress: 12.77 ksi 60% ult. Stress 12.77 ksi 60 * ult. Stress: 12.77 ksi 60% ult. Elap. Elap. Accum. Elap. Accum. Accum. Strain Strain Remarks Remarks Time Time Strain Remarks Time (µ in/in) (Pin/in) (min/in) (hrs.) (hrs.) (hrs.) 5283 5682 5811 0.017 0.017 0 -017 6022 5907 5540 0.10 5840 0.10 6198 0.10 6312 0.25 6033 0.25 6387 0.25 6507 0.50 6158 0.50 6556 0.50 6678 1 1 1 63.63 6721 6851 6585 2 6945 7082 6685 7045 7186 7223 7374 6894 7 7034 7360 7 7 7504 8 7407 7558 8 7088 24 7468 24 7764 24 7928 73 8000 73 8246 73 8466 146 8578 146 8726 146 8992 223 8845 8944 223 223 9209 413 91.69 413 9217 413 9513 503 9211 503 9256 503 9553 Recovery Recovery Recovery 3905 load off 0 3903 load off 4050 load off 0.5 3337 0.5 3314 <u>0.5</u> 3390 3060 3020 3086 2905 2859 2915 2805 2753 2807

Test: Creep Crient: 245° Crie					V378A					
Spec. No: I3-10 Spec. No: I4-1 Spec. No: I5-5 Temp: 350*F(177*C) Temp: 350*F(177*C) Temp: 350*F(177*C) Stress: 12.89 ksi 80* ult. Stress: 12.89 ksi 80* ult. Stress: 12.89 ksi 80* ult. Elap. Accum. Time Strain (hrs.) (μ in/in) Flap. Accum. Time Strain (hrs.) (μ in/in) Flap. Accum. Time Strain (hrs.) (μ in/in) 0 11492 0 10487 0 11051 0.017 13527 0.017 11861 0.017 13137 0.10 16264 0.10 13050 0.10 14655 0.25 16961 0.25 13458 0.25 15063 0.50 17336 0.50 13950 0.50 15421 1 17856 1 14615 1 15954 2 18465 2 15018 2 17077 3 18986 3 15325 3 02 5690 123 25690 123 21609 193 26420 194 21993 235 27249 235 22869 307 28551 307 24266 404 30384 404 25714	Test:_	Creep		Test:	Creep		Test:	Creep		
Temp: 350°F(177°C) Stress: 12.89 ksi 80° ult. Elap. Accum. Time Strain Remarks (hrs.) (μin/in) 0 11492 0 0 10487 0.017 13527 0.10 16264 0.25 16961 0.25 16961 1 17856 1 14615 1 17856 2 18465 2 18465 2 15018 2 15018 2 15028 2 15018 2 17077 3 18886 3 15325 2 1 16965 2 15063 2 17077 3 18886 3 15325 3 gage failed 2 123 25690 193 26420 194 21993 235 27249 307 28551 307 24266 404 30384	Orient: ±45°			Orient: +45*			Orient: +45°			
Stress: 12.89 ksi sow ult. Stress: 12.89 ksi sow ult. Stress _ 12.89 ksi sow ult. Stress _ 12.89 ksi sow ult. Stress _ 12.89 ksi sow ult. Elap. Accum. Time Strain (hrs.) (μin/in) Elap. Accum. Time Strain (hrs.) (μin/in) Elap. Accum. Time Strain (hrs.) (μin/in) Remarks (hrs.) (μin/in) Co.017 13137 O.017 13527 O.017 12861 O.017 13137 O.10 14655 O.25 15063 O.10 14655 O.25 15063 O.50 17336 O.50 13950 O.50 15421 O.50	Spec. No: 13-10			Spec. I	Spec. No: 14-1			Spec. No: 15-5		
Elap. Accum. Time (hrs.) (μ in/in) Remarks (hrs.) (μ in/in) Elap. Accum. Time (hrs.) (μ in/in) Remarks (hrs.) (μ in/in) Elap. Accum. Time (hrs.) (μ in/in) Remarks (hrs.) (μ in/in) Elap. Accum. Time (hrs.) (μ in/in) Remarks (μ in/in) Remarks (hrs.) (μ in/in) Remarks (μ in/in) Remarks (hrs.) (μ in/in) Accum. Time (hrs.) (μ in/in) Remarks (μ in/in) Remarks (μ in/in) Accum. Time (hrs.) (μ in/in) Remarks (μ in/in) Remarks (in/in) Accum. Time (hrs.) (μ in/in) Remarks (μ in/in) Accum. Time (hrs.) (μ in/in) Remarks (μ in/in) Accum. Time (hrs.) (μ in/in) Remarks (μ in/in) Accum. Time (hrs.) (μ in/in) Acc	Temp: 350°F(177°C)			Temp:	350°F(17	7°C)	Temp	350°P(1,7)	<u>(*c)</u>	
Time (hrs.) (μ in/in) Remarks (μ in/in) Time (hrs.) (μ in/in) Strain (hrs.) (μ in/in) Time (hrs.) (μ in/in) Time (hrs.) (μ in/in) Time (hrs.) (μ in/in) Remarks (hrs.) (μ in/in) 0.017 13527 0.017 11861 0.017 13137 0.10 14655 0.10 14655 0.10 14655 0.10 14655 0.25 15063 0.25 15063 0.25 15063 0.25 15063 0.25 15063 0.50 15421 1 15954 1 15954 1 15954 1 15954 1 15954 1 15954 1 15954 1 16965 <t< td=""><td colspan="3">Stress: 12.89 ksi 80% ult.</td><td>Stress</td><td>12.89 ks</td><td>801 ult.</td><td>Stres</td><td>12.89</td><td>80 tult.</td></t<>	Stress: 12.89 ksi 80% ult.			Stress	12.89 ks	801 ult.	Stres	12.89	80 tult.	
(hrs.) (μ in/in) (hrs.) (μ in/in) (hrs.) (μ in/in) 0 11492 0 10487 0 11051 0.017 13527 0.017 11861 6.017 13137 0.10 16264 0.10 13050 0.10 14655 0.25 16961 0.25 13458 0.25 15063 0.50 17336 0.50 13950 0.50 15421 1 17856 1 14615 1 15954 2 18465 2 15018 2 17077 3 18886 3 15325 3 qaos failed 21 20535 21 16965 502 no failed 123 25690 123 21609 194 21993 235 27249 235 22869 3 1307 24266 404 30384 404 25714 1 1 13151 1 1 1 1 1 1 1 1 1 1 1 </td <td>, .</td> <td>1</td> <td>Remarie</td> <td></td> <td></td> <td>Demarke</td> <td></td> <td></td> <td>Remarks</td>	, .	1	Remarie			Demarke			Remarks	
0 11492 0 10487 0 11051 0.017 13527 0.017 11861 0.017 13137 0.10 16264 0.10 13050 0.10 14655 0.25 16961 0.25 13458 0.25 15063 0.50 17336 0.50 13950 0.50 15421 1 17856 1 14615 1 15954 2 18465 2 15018 2 17077 3 18986 3 15325 3 gao: failed 21 20535 21 16965 502 no failure 123 25690 123 21609 194 21993 235 27249 235 22869 1 307 28551 307 24266 1 404 30384 404 25714 1	1 -	7			,		1			
0.017 13527 0.017 11861 0.017 13137 0.10 16264 0.10 13050 0.10 14655 0.25 16961 0.25 13458 0.25 15063 0.50 17336 0.50 13950 0.50 15421 1 17856 1 14615 1 15954 2 18465 2 15016 2 17077 3 18886 3 15325 3 gage failed 21 20535 21 16965 502 no faile 123 25690 123 21609 194 21993 235 27249 235 22869 307 24266 404 30384 404 25714 404 25714		 								
0.10 16264 0.10 13050 0.10 14655 0.25 16961 0.25 13458 0.25 15063 0.50 17336 0.50 13950 0.50 15421 1 17856 1 14615 1 15954 2 18465 2 15018 2 17077 3 18986 3 15325 3 gaoe failed 21 20535 21 16965 502 no failed 123 25690 123 21609 194 21993 235 27249 235 22869 307 24266 404 30384 404 25714 404 25714	0.017	13527		0.017						
0.25 16961 0.25 13458 0.25 15063 0.50 17336 0.50 13950 0.50 15421 1 17856 1 14615 1 15954 2 18465 2 15018 2 17077 3 18986 3 15325 3 gaoe failed 21 20535 21 16965 502 no failure 123 25690 123 21609 194 21993 235 27249 235 22869 307 24266 404 30384 404 25714 404 25714	0.10	16264				<u></u>		<u>}</u>	1	
0.50 17336 0.50 13950 0.50 15421 1 17856 1 14615 1 15954 2 18465 2 15018 2 17077 3 18986 3 15325 3 gage failed 21 20535 21 16965 502 no failure 123 25690 123 21609 0 0 6ailure 193 26420 194 21993 0 0 6ailure 0 </td <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td><u> </u></td> <td></td>								<u> </u>		
1 17856 1 14615 1 15954 2 18465 2 15018 2 17077 3 18986 3 15325 3 gage failed 21 20535 21 16965 502 no faile 123 25690 123 21609 193 26420 194 21993 235 27249 235 22869 307 28551 307 24266 404 30384 404 25714							<u> </u>			
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3 18886 3 15325 3 gage failed 21 20635 21 16965 502 no failure 123 25690 123 21609 193 26420 194 21993 235 27249 235 22869 307 28551 307 24266 404 30384 404 25714	-				· · · · · · · · · · · · · · · · · · ·		-			
21 20535 21 16965 502 no failure 123 25690 123 21609 194 21993 235 27249 235 22869 194 22869 307 28551 307 24266 194 22714 404 30384 404 25714 198 198									led	
123 25690 123 21609 193 26420 194 21993 235 27249 235 22869 307 28551 307 24266 404 30384 404 25714										
193 26420 194 21993 235 27249 235 22869 307 28551 307 24266 404 30384 404 25714	123	1		123						
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404 30384 404 25714	235	27249			22859					
	307	28551		307	24266					
502 32124 502 27366	404	30384		404	25714					
	502	32124		502	27366	<u> </u>	<u> </u>			
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Recovery Recovery	Recovery			Recovery			Recovery	r		
0 24193 load off 0 20031 load off	0	24193	load off	0	20031	load off				
1 22158 1 18007										
2 21.051 2 17760				2	1					
3 21610 3 17560	3			3				<u></u>		

V378A

Creep Test: Creep Test: Test: ±45° <u>+</u>45° Orient: ±45° Orient: Orient: Spec. No: 13-3 Spec. No:_ 16-9 Spec. No: 17-7 Temp: 350°F(177°C) Temp: 350°F(177°C) Temp:__ 350°F (177°C) Stress 11.28 ksi 70 % wit. Stress: 11.28 ksi 70% ult. Stress: 11.28 ksi 70 % ult. Elap. Accum. Elap. Accum. Elap. Accum. Time Strain Remarks Time Strain Remarks Strain Remarks Time (µ in/in) (hrs.) (Hin/in) (µin/in) (hrs.) page failed on loading 6517 0 9133 0.017 7406 527 no failure 0.017 9387 0.10 7836 0.10 10115 0.25 8460 0.25 10622 0.50 9074 11084 9588 11526 10106 12028 10428 12348 10781 4.5 4.5 12654 10910 11012 12968 24 11974 14481 144 13443 144 16692 14177 240 17379 336 14724 17857 14772 361 361 15350 408 18178 527 16428 Recovery Recovery Recovery load off 10848 load off 8789 0.5 8647 12456 2 8329 2 12257 7719 6 6

V378A Creap

Test:	Craep		Test:
Orient	: <u>+45°</u>	-	Orient:
Spec. 1	io: <u>13-1</u>		Spec. N
Temp:	350°F (177°C)	Temp:_
Stress	: 9.67 ks	i_60 % w.t.	Stress:
Elap. Time	Accum.		Elap.
		Remarks	Time
(hrs.)	(# in/in)		(hrs.)
0	4584		0
0.017	4885		0.017
0-10	5477		0.10
0.25	5904		0.25
0.50	6276		0.50
1	6647		1
4	7585		4
6	7911		6
7	8074		7
8	8183		8
30	9227		30
120	9981		120
222	10196		242
320	10393		320
456	10690		456
476	10719		476
510	10745		510
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	Recover	y	
0	5605	load off	
0.5	6194		0.5
1	6068	-	1
1.5	6025	1	1.5

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Orient	: <u>+</u> 45°						
Spec. 1	No: 14-8						
Termp: 350°F(177°C)							
Stress: 9.67 ksi 60 % ult.							
Elap.	Accum.						
Time	Strain	Remarks					
(hrs.)	(Hin/in)						
0	5188						
0.017	5588						
0.10	5918						
0.25	6153						
0.50	6370						
1	6526						
4	7127						
6	7406						
7	7501						
8	7568						
30	8673						
120	10282						
242	11046						
320	11600						
456	12769						
476	12967						
510	131.72						
}							
1							
	 						
	 						
		1					
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-		i					
	Recovery						
0	8565	load off					
0.5	7995						
1	7839	1					
1.5	7781						

Test:	Creep	
Orient	±45°	
i	No: 15-3	
Temp:	350°F(1	77°C)
Stress	9.67 ksi	60 % ult.
Elap.	Accum.	
		Remarks
1	(µin/in)	
U J	5397	
0.017	5488	
0.10	5580	
0.25	yage fai	
510	no failu	re
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V376A

Test: Cresp			Test: Creep			Test: Creep		
	: <u>+</u> 45*		Orient: +45°			Orient: ±45°		
Spec. No: 15-2			Spec. No: 16-5			Spec. No: 16-10		
Temp: 450*F(232°C))	450°F(2			450°F(23	1
Stress: 11.95 ksi 80% uit.		}	,,	80 % wlt.	1	11.95 ksi		
Elap.	Accum.		Elap.	Accum.		Elap.	Accum.	
Time		Remarks	Time	t	Remarks	Time	Strain	Remarks
	(µin/in)			(Pin/in)			(µin/in)	
0	<u></u>	lon loading	0	gage fa		٥	7414	
528	no fai	ure	0.017	fail	ure	0.017	7950	
						0.10	8545	
						0.25	9167	
						0.50	9560	
						1	10875	
<u></u>						1.5	yage fai	led
						191	failur	e
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Recovery			Recovery			Recovery	7	
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V378A Creep

Creep Creep Test: Test: Creep Test: ±45° ±45* Orient: Orient: Orient: #45* Spec. No: 15-8 Spec. No: 17-4 Spec. No: 18-2 Temp: 450 F(232°C) Temp: 450°F(232°C) Temp: 450*F(232*C) Stress 10.45 ksi 70% ult. Stress: 10.45 ksi 70% ult. Stress: 10.45 ksi 70 % uit. Elap. Accum Elap. Accum. Elap. Accum. Strain Strain Remarks Time Strain Remarks Time Remarks (µin/in) (hrs.) (# in/in) (hrs.) (Fin/in) (hrs.) 7816 7963 6257 0.017 0.017 9064 9042 0.017 6737 0.10 10972 0.10 12126 0.10 7206 0.25 11798 0.25 gage failed 0.25 7506 0.50 12595 no failure 0.50 7732 503 8012 13608 14465 2 8277 15443 8591 15823 8706 16526 8975 16694 10093 gage failed 23 23 503 no failure 10924 119 11735 220 12359 360 12841 456 12912 503 12970 Recovery Recovery Recovery load off 0 8653 0.5 8055 7944 1 7834

V378A

				V378A				
1	est: Creep Test: Creep				Test: Creep			
Orient	Orient: 0/±45/90*			: 0/+45/9	0•	Ories	: 0/+45/9	0*
Spec. N	Spec. No: 125-6			No: 128	-5	Spec.	Spec. No: 135-2	
Temp:	72*F(22*	<u>'C)</u>	Temp	72*F(2	2°C)	Temp	Temp: 72°F(22°C)	
Stress	: 101.76 ks	d 85% ult.	Stress	101.76	85% ult.	Stress	101.76 kgi	85 % ult.
	Accum.			Accum.		Elap.		
	5	Remarks	£ .	1	Remarks	1 1	,	Remarks
	(# in/in)		-	("in/in)			(µin/in)	
0	10076		0	failure	on loading	0	failure on	loading
0.017	10087							
0.10	10110							
0.25	10128							
0,50	10138							
1	10150							
2	10160							
4	10175							
5	10176							
6.8	10180							
7.5	10184							
24	1.0203							
119	10253				1			
216	10237				1			
314	10232		i			1		
390	10213							
455	10230				1			
527	10218							
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	Recover	y		Recovery		1	Recovery	·
0	348	load off						
0.5	288							
1	271				1			
5	224							

Creep

Test:

Test:

Test:	Creep							
Orient	0/±45/90	•						
	No: 137-4							
Temp:	72*9(22	*c)						
Strass	Strass: 95.20 ksi 79% ult.							
Elap.	Accum.							
Time	Strain	Remarks						
	(µ in/in)							
0	7672							
0.017	7698							
0.10								
0.25	7733							
0.50	7742							
1	7750							
65	7838							
91	7850							
168	7845							
239	7856							
401	7879							
503	7850							
<u> </u>								
	1							
	!							
ļ	1							
	Recover	у						
0	340	load off						
0.5	302							
1	292							

The state of the s						
Orient	: 0/+45/9	0°				
Spec. No: 139-4						
Temp: 72*F(22*C)						
Stress:	95.20 ks	_ 79 % w1€.				
Elap.	Accum.					
Time	Strain	Remarks				
(hrs.)						
0	7862					
0.017	7881					
0.10	7903					
0.25	7 9 18					
0.50	7926					
1	7935					
65	8012					
91	8020					
168	8043					
239	8056					
401	8075					
503	8045					
		<u> </u>				
	į	<u> </u>				
	<u> </u>					
	<u> </u>	<u> </u>				
	l	 				
	<u> </u>	 				
	1	<u>!</u>				
		-				
	Recovery	<u> </u>				
0	336	load off				
0.5	291					
1	283					
·						

Orient: 0/+45/90°						
Spec. No: 146-4						
Temp: 72*F(22*C)						
Stress 95.20 ksi 79% ult.						
Elap.	Accum.					
Time		Remarks				
(hrs.)	(µin/in)	 				
0	7920					
	7947					
0.10	7978					
	8000					
0.50	8007					
1	8020					
65	8106					
91	8120					
168	8110					
239	8122					
401	8146					
503	8113					
	<u> </u>					
	<u> </u>					
	<u> </u>					
		<u> </u>				
	<u> </u>	<u>!</u>				
	<u> </u>	-				
	<u> </u>	 				
	<u> </u>					
	<u> </u>	1				
	 	1				
	1	 				
	<u> </u>	<u> </u>				
	Recovery					
	300	load off				
0.5	250					
	1 245					
		1 1				

				V378A				
Test:	Creep		Test:	Creep		Test:	Crean	
Orient	: 0/ <u>+</u> 45/90		Orient	: 0/+45/	90°	Orient: 0/+45/90°		
Spec. 1	No: 129-5		Spec. 1	Spec. No: 138-4		Spec.	No: <u>114-</u>	3
Temp:	72°F(22°	c)	Temp	72°F(22	°C)	Temp	72°F(22°	c)
Stress	: 81.24 ks	i 68% ult.	Stress	81.24 kS	68 ult.	Stres	8 <u>81,24</u> ksi	68 Ult.
Illap. Time	Accum. Strain (µin/in)	Remarks	Time	Accum. Strain (#in/in)	Remarks	Time	Accum. Strain (µin/in)	Remarks
0	7448		0	7300		(411.3-1		
0.017	7477		0.017	7325		0.017	7317	
0.10	7500						7330	
0.25			0.10	7344		0.10	7356	
	7510		0.25	7354		0-25	7372	
0.50	7516		0.50	7358		0.50	7379	
1	7526		1	7371		1	7388	
5	7538	<u> </u>	5	7380		2	7391	
6	7544		6	7387		3	7400	
29	7562		29	7407		4	7400	
78	7579		78	7425		5	7401	
149	7598		149	7443		6	7402	
311	7628		311	7472		7	7407	
503	7622		503	7465		78	7453	
						240	7496	
		<u> </u>	<u></u>			432	7486	
						505	7483	
			L				1	
						<u> </u>		
						 		
						<u> </u>		1
								1
]		
	1							
			-		1			
	Recover	7		Recovery			Recovery	,
0	321	load off		299	load off		271	load off
1	244		1	222	<u> </u>	1 1	196	ļ
2	230		2	214		1.5	188	
2.5	222		2.5	211] 2	182	

Test: Creep 0/+45/90* Orient: 350°F (177°C) Temp: Stress: 84.86 ksi80 % ult. Elap. Accum. Time Strain Remarks (hrs.) (# in/in) 7651 0.017 7761 0.10 7663 0.25 7693 0.50 7698 1 7683 7688 7666 5 7699 6.9 8434 7.5 7668 24 7682 119 7806 217 7805 315 7733 390 7683 455 7661 532 7614 Recovery -85 load off 0 -111 0.5 1 -116 -134

V378A								
Test: Creep								
Orient: 0/+45/90°								
Spec. No: 136-3								
Temp:	Temp: 350°F(177°C)							
Stress:	84.86 ks	80% ult.						
Elap.	Accum.	·						
Time	Strain	Remarks						
(hrs.)	(Pin/in)							
0	6906							
0.017	6922							
0.10	6919							
0.25	6833							
0.50	6786							
1	6724							
2	6731							
4	6705							
5	6676							
6.9	6972							
7.5	6683							
24	6609							
119	6624							
217	7145							
315	7250							
390	7302							
455	7385							
532	7475							
	Recovery	<u></u>						
0	-554	load off						
0.5	-865							
1	-908							
5	-985							
-								

V378A

Test:						
Orient: 0/+45/90°						
Spec.	No: 140-5					
Temp	350°F(1	77°C)				
Stress	84.86 ksi	. 80° ult.				
Elap.	Accum.					
Time	Strain	Remarks				
(hrs.)	(gin/in)					
0	7312					
0.017	7361					
0.10	7403					
0.25	7424					
0.50	7441					
1.	7447					
2	7459					
4	7464					
5	7467					
6	7470					
7	7474					
26	7497					
145	7472					
222	7471					
295	7522					
361	7489					
455	7534					
530	7569					
<u> </u>						
	Recovery					
0	364	load off				
0.5	329					
	322					
4 5	320	<u> </u>				
2	316					

					V378A		
Test: Creep			Tes	Test: Cresp			
Orient	: 0/+45/90	0°	Orie	Orient: 0/+45/90°			
Spec. 1	Spec. No: 213-5			Spec. No: 114-4			
Temp:	350~P(17	7°C)	Text	.p:_	350°7(1	77°C)	
Stress	74.25 ks	i 70% ult.	Street	58 t	74.25 kSi	. 70% ult.	
Elap. Time (hrs.)	1	Remarks	Elap Tim (hrs		Accum. Strain (#in/in)	Remarks	
0	7110		0	1	6793		
0.017	7140		0.01	7	6824		
0.10	gage :	ailed	0.1	0	6830		
507	no fai	lure	0.2	5	6809		
			0.5	0	5817		
ود می داند می داند ا			1		6809		
			1.5	\Box	6811		
			2		6807		
			4		6807		
			5	_ _	6803		
			6		6794		
			63		6748		
			160	_	6678		
			175	_	6732		
			232	-	6821		
			304	-	6605		
			401	-	6588		
<u></u>	<u> </u>	· · · · · · · · · · · · · · · · · · ·	483		6579		
			507	-	6561		
<u></u>				-			
				-			
				十			
			 	\dashv	···		
				+			
				+			
				\dashv		· · · · · · · · · · · · · · · · · · ·	
·	Recover	7		R	ecovery		
			0		-95	load off	
			0.5		-110		
			1		-122		
			2	J	-131		
			3		-140		

Test: Creep					
Orient	: 0/+45/9	0.			
Spec.	No: <u>137-5</u>				
Temp	350°F(17	7°C)			
Stress	<u>74.25</u> ks:	70 % ult.			
Elap.	Accum.				
Time	Strain	Remarks			
(hrs.)	(Hin/in)				
O	6255				
0.017	6260				
0.10	6268				
0.25	6270				
0.50	6270				
1	6271				
1.5	6272				
2	6274				
4	6278				
5					
6					
63					
160	6244				
175	6229				
232	6228				
304	6218				
401	6213				
483	6208				
507	6207				
		1			
	Recovery				
0	156	load off			
0.5	93				
	83				
2	72				
3	66				

HyE 1076J

Test: Creep	Test: Craep	Test: Creep		
Oriens: +45°	Orient: +45°	Orient: <u>+45*</u>		
Spec. No:	Spec. No: <u>37-3</u>	Spec. No: J4-4		
Temp: 72°F(22°C)	Temp: 72°F(22°C)	Temp: 72°F(22°C)		
Stress: 20.05 ksi90 % ult.	Stress: 20.05 ksi 90% uit.	Stress 20.05 ksi 90 ult.		
Elap. Accum.	Elap. Accum.	Elap. Accum.		
Time Strain Remarks	Time Strain Remarks	Time Strain Remarks (hrs.) (µin/in)		
(hrs.) (μ in/in)	(hrs.) (#in/in)	0 9860		
0 11746	0 failed on loading			
0.017 12620		0.10 10773 0.17 Failure		
0.10 13652		0.17 Failure		
0.25 14735				
0.42 failure				
Recovery	Recovery	Recovery		
		J		

事務を発を利益の政権を対象を対象を対象が対象というという。

Test: Creep +45* Orienti Spec. No: 37-2 Temp: 72°F (22°C) Stress: 17.83 ksi 80% ult. Elap. Accum. Time Strain Remarks (µ in/in) (hrs.) 0 6830 0.017 7362 0.10 7726 0.25 7925 0.50 3096 1 8260 3 8576 4 8656 8690 8748 46 9193 142 9618 240 3938 310 10158 407 10330 504 10664 Recovery 3212 load off 0.5 2502 2082 2 1974 1804

	HyE 107	6J					
Test:	Creep						
Orient	Orient: +45°						
Spec. I	No: 37-8						
Temp:	72°F(22	<u>°C)</u>					
Stress:	17.83 kg	30 % ult.					
Elap.	Accum.						
Time		Remarks					
	(Pin/in)						
0	6470						
0.017	6718						
0.10	6984						
0.25	7134						
0.50	7251						
1	7388						
3	7624						
4	7692						
5	7712						
6							
46	7760						
142	8108 8480						
240	8718						
310	8873						
407	8996						
504	9242						
304	7444						
	 						
		 					
	Recovery	·					
Q	2386	load off					
0.5	1678						
1	1539						
2	1382						
3	1328	······					

Test:_	Creep					
Orient	±45°					
Spec. No: 110-3						
Temp:	72°F(22	<u>*c)</u>				
Stress	17.83 ksi	. 30 % wit.				
Elap.	Accum					
Time	Strain	Remarks				
(hrs.)	(µin/in)					
0	6126					
0.017	6318					
0.10	6545					
0.25	6684					
0.50	6801					
1	6922					
3	7146					
4	7208					
5	7225					
6	7268					
46	7600					
142	7926					
240	8118					
310	8258					
407	6370					
504	8586					
		1				
	Recovery					
0	2107	load off				
0.5	1494					
1	1374					
1 ^	1	i				

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Test: Creep Test: Creep Test: Orient: +45° Orient: +45° Spac. No: J12-3 Spec. No: J8-8 Temp: 72°F(22°C) Temp: 72*F(22*C) Stress: 15.60 ksi 70% ult. Stress: 15.60 ksi 70 % ult. Elap. Elap. Accum. Accurr. Time Strain Remarks Time Strain Remarks (hrs.) (# in/in) (hrs.) (Hin/in) 6229 6334 0.017 6370 0.017 6728 0.10 6586 0.10 6914 0.25 6716 0.25 7065 0.50 6806 7166 0.50 6900 7268 2 6996 2 7387 4 7094 7490 4 7142 6 6 7546 8 7172 8 7580 24 7395 24 7828 176 7732 176 8220 272 7881 272 8391 390 7996 390 8528 508 8115 SOB 8664 Recovery Recovery Load off 1907 Load off 1084 0.5 0.5 1352 1014 1268 1193 944

	Test: Creap			
ì	Orient: +45°			
Spec.	No: <u>19</u> -	-3		
Temp	Temp: 72°F(22°C)			
Stress	15.60 Veri	70. ult.		
Elap.	Accum.			
Time	Strain	Remarks		
(hrs.)	(µin/in)			
0	6018			
0.017	6240			
0.10	6426			
0.25	6555			
0.50	6644			
1	6737			
2	6831			
4	6928			
6	6978			
8	7006			
24	7222			
176	7554			
272	7703			
390	7807			
508	7923			
	Recovery			
<u> </u>	1840	Load off		
0.5	1122			
1	1053			
2	985			

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HyE 1076J Test: Creep Test: Creep Test: Creep +45° Orient: +45° Orient: Orient: Spec. No: 26-4 Spec. No: J12-4 Temp: 260°F(127°C) Temp: 260°F(127°C) Temp: 260°F(127°C) Stress: 13.19 ksi 60% ult. Stress 13.19 ksi 80 % ult. Stress: 13.19 ksi 80% ult. Elap. Accum. Elap. Accum. Elap. Accum. Time Strain Remarks Strain Time Remarks Strain Remarks Time (Fin/in) (hrs.) (µin/in) (hrs.) (hrs.) (Fin/in) 6138 6111 0 8561 0.017 6356 0.017 6257 0.017 8810 0.10 7203 0.10 7247 0.10 11295 7677 0.25 0.25 7831 0.25 16967 0.50 8046 0.50 8321 0.50 gage failed 8402 8771 no failure 8393 9222 66 10226 66 gage failed 116 gage failed 501 501 no failura Recovery Recovery Recovery

HyE 1076J Creer Test Test: ±45° <u>+45°</u> Orient: Orient: Spec. No: 33-7 Spec. No:_ 35-3 260°F(127°C) Temp: Temp: 260°F(127°C) Stress: 11.55 ksi 70 % ult. Stress: 11.55 kgi 70 % uit. Elap. Accum. Elap. Accum. Time Strain Remarks Time Remarks Strain (Pin/in) (hrs.) (hrs.) (Fin/in) 7071 4590 0.017 gage falled 0.017 4869 failur 0.10 5010 0.25 5139 0.50 5273 5414 5576 3 5715 4 5778 5 5804 25 6267 100 6882 203 7351 246 7516 270 7559 7876 8011 446 8170 Recovery Recuvery 3887 Load off 0.5 3348 1 3248 2 3123 3C40

Test: Creep				
Orient: <u>+45°</u>				
Spec.	Spec. No: 39-16			
Temp	260°F(12	7°C)		
Stress	<u> 11.55</u> asi	70 % ult.		
Elap.	Accum.	1		
Time	Strain	Remarks		
(hrs.)	(µin/in)			
0	5038			
0.017	5315			
0.10	5560			
0.25	5713			
0.50	5853			
1	6000			
2	6162			
3	6316			
4	6386			
5	6409			
25	6918			
100	7567			
174	7991			
246	8327			
270	8403			
395	8836			
446	9016			
508	9202			
	<u> </u>			
Recovery				
0	4463	Load off		
0.5	3754			
1	3641			
2	3511			

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Test:_	Creen		Test:_	Creep		Test:	Creep	
Orient	±45°		Orient	<u>+45°</u>		1	: <u>+45°</u>	
Spec. N	io: J6-3		Spec. I	No: J7-10		Spec.	No: J8-3	
Temp:	260°F(127	<u>(c)</u>	Temp:	260°F(1	27°C)	Temp	260"F()	27°C)
Street	: 9.90 ks	i_60 * ult.	Stress	9,90	60 tult.	Stress	9.90 ksi	60 tult.
Time	Accum. Strain (# in/in)	Remarks	Time	Accum. Strain (Fin/in)	Remarks	Elap. Time (hrs.)	Strain	Remarks
0	4754		0	4128		0	3932	
0.017	3107		0.017	4263		0.017	3990	
6.10	5592		0.10	4632		0.10	4503	
0.25	5691		0.25	4916		0.25	4782	
0.50	5728		0.50	4911		0.50	5010	
1	5768		1	4996		1	5269	
2	5832		2	5115		2	5587	
3	5870		3	5184		3	5793	
25	5114		25	5551		25	7081	
122	6448		122	5945		122	8799	
213	6657		219	6146		219	9779	
337	6846		337	6332		337	10653	
456	7044		456	6491		456	11462	
504	7101		504	6546		504	11740	
			1					
	71 THE							
					I			
	Recover	7		Recovery			Recovery	,
0	3021	Load off	0	2934	Load off	0	7984	Load off
0.5	2722		0.5	2629	1	2.5	7632	
1	2660			2550	<u> </u>		7468	
2	2590	1 1	2	2476	i	2	7357	1

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HyE 1075J Creen

Test: Test: Czeeb Orient: +45° Orient: +45° Spec. No: 18-4 Spec. No: J3-3 Temp: 350°P(177°C) Temp: 350°F(177°C) Stress: 13.28 ksi 80 % ult. Stress: 13.28 kei 80 % ult. Elap. Elap. Accum. Accum. Time Strain Remarks Time Strain Remarks (hrs.) (# in/in) (hrs.) (Fin/in) 11149 7146 0.017 11960 0.017 7563 0.10 12634 0.10 8201 0.25 12956 0.25 8324 0.50 13069 0.50 8367 18850 19288 1 4 25946 4 22202 24 29040 26287 24 142 44824 gage failed 142 gage failed no failure no failure Recovery Recovery

Test: Creen Orient: +45° Spec. No: <u>J11-5</u> Temp: 350°F(177°C) Stress 13.28 kgi 30 t ult. Elap. Accum. Strain Remarks Time (µin/in) (hrs.) 8204 0.017 8431 0.10 9416 0.25 9691 0.50 9756 1 gage failed 503 no Enime Recovery

HyE 1076J Creep Test: Creep Test. +45° Orient:_ Orient: +45* Spec. No: 14-7 Temp: 350°F(177°C) Temp: 350°F(177°C) Stress: 11.62 ksi 70 % ult. Stress: 11.62 ksi70 % ult. Elap. Accum. Elap. Accum. Time Strain Remarks Time Strain Remarks (hrs.) (# in/in) (brs.) (#in/in) 10676 9641 0.017 11179 0.017 10195 0.10 12510 10942 0.10 0.25 13308 0.25 12141 0.50 13813 0.50 13052 1 14531 13815 1 2 11002 14531 2 24 12677 21027 24 146 19627 gage failed 146 18960 502 no failure 360 19330 502 19410 Recovery Recovery Load off 15759 0.5 15588 15556 15525

Test:	Test: Creep				
	Orient: +45°				
1					
	Spec. No: <u>J10-9</u>				
	350°F(1			
Stress	<u> 11.62</u> ksi	70 ult.			
Elap.	Accum.				
Time	Strain	Remarks			
(hrs.)					
0	11268				
0.017	11859				
0.10	13032				
0.25	14192				
0.50	14966				
1	16099				
2	16729				
24	gage fa				
502	no failt	re			
	<u> </u>	 			
	<u> </u>				
	<u> </u>				
		 			
ļ	 				
 -	{ i	 			
Ranguani					
Recovery					
	<u> </u>				

Test: Creep Orient: ±45° Temp: 350°F(177°C) Stress: 9.96 ksi 60 % ult. Elap. Accum. Time Strain Remarks (µ in/in) (hrs.) 4895 0 0.017 5373 0.10 6350 7038 0.25 0.50 7554 8195 ì 2 9087 2.5 9388 gage failed 24 504 no failure Recovery

Orient: ±45° Spec. No: J10-8 Temp: 350°F(177°C) Stress: 9.96 ksi 60 % ult. Elap. Accum. Time Strain Remarks (hrs.) (#in/in) 0 5792 0.017 6289 7821 0.10 0.25 8631 0.50 9303 1 10145 11142 2 2.5 11376 24 18847 74 144 gage failed no failure 504 Recovery

HyE 1076J

Creep

Test:

Test	Creep		
	-		
Orient: +45*			
Spec. No: <u>J11-4</u>			
Temp	Temp: 350°F(177°C)		
Shrake	3.96 ksi	sot ult.	
Elap.	Ascum. Strain	Remarks	
(hrs.)	(#in/in)	Vemerva	
0	5444		
0.017	5698		
0.10	6129		
0.25			
0.50	7142		
1	7!75		
2	8429		
2.5	8640		
24	14049		
74	19672		
144	23880		
241	28059		
339	gage fai	1	
504	no fail	re	
ļ	1		
		}	
	<u> </u>	1	
	 		
		i	
	<u> </u>	1	
	Recovery	•	
1	i	1	

HyE 1076J

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Test:_	Test: Creep Test: Creep		Test: Creep					
Orient	: 0/+45/90	•	Orient	0/+45,	/90*	Orient	0/+45/90)*
Spec. 1	No: J16-8		Spec.	No: J13-	7	Spec.	No: J17-6	
Temp:	72°F(22°	c)	Temp:	72°F(22°	°C)	Temp	72*F(22	°C)
Stress	: 93.46 ks	i 80 % ult.	Stress	93.46	i 80 % ult.	Stress	5tress 93.46 ksi 80 ult.	
Elap.	Accum.		Elap.	Accum.		Elap.	Accum.	
Time	Strain	Remarks	Time	Strain	Remarks	Time	Strain	Remarks
(hrs.)	(# in/in)		(hrs.)	(Fin/in)		(hrs.)	(uin/in)	
0	6344		O	failed o	n loading	0	failed or	loading
0.017	8378							
0.10	8400							
0.25	8428							
0.50	8438							
1	8425							
65	9586							
114	8566							
233	8592							
406	8589							
500	8583					L		
					<u></u>			
					<u> </u>	 	<u> </u>	
							<u> </u>	
							<u> </u>	
	}				<u> </u>			<u> </u>
	Racover	7	Recovery			Recovery		
0	636	load off						
1	572							!
2	512			1		[]		
3	508					1	<u> </u>	

ByE 1076J

T	Creep	······································	Tart	Creep				
1 -			4			Test: Craep		
1	: 0/+45/90		Orient: 0/+45/90°		ł	: 0/+45/		
	pec. No:			Spec. No: J13-9			No: <u>J15-1</u>	
Temp:	72°F(22°	(C)	Temp	72°F(2	2*C)	Temp:	72*F{22	°C)
Stress	:81.77ks	1 <u>70</u> % ult.	Stress	81.77 kS	701 ult.	Stress	81.77 ksi	_701 wit.
	Accum.		Elap.	Accum.		Elap.	Accum.	
Time		Remarks	Time		Remarks	Time		Remarks
(hrs.)	(Fin/in)		(brs.)	(Fin/in)		(hrs.)	(µin/in)	
0	6446		0	6722		0	6760	
0.017	6469		0.017	6744		0.017	6784	
0.10	6486		0.10	6758		0.10	6810	
0.25	6493		0.25	6763		0.25	6822	
0.50	6496		0.50	6771		0.50	6830	
1	6500		1	6773		1	6840	
2	6499		2	6777		2	6843	
3	6500		4	6788	·	24	6850	
4	6496		5	6789		197	6852	
5	6534		6	6788		240	6856	
6	6516		7	6790		363	6892	
24	6535		.24	6787		415	6896	
52	6534		127	6762		502	6887	
112	6561		223	6807				
249	6585		341	6783				
355	6598		465	6803				
424	6613		508	6785				
500	6620							
	Recovery	7		Recovery			Recovery	
0	188	load off	0	78	load off	0	48	load off
0.5	160		0.5	42		0.5	16	
1	152		1	32		1		
5	134		2	68				<u> </u>
			3	61		3	6	

7.55	Creep		Teer	HyE 1076J Creep		7.55	Croon	
-			_			_	Creep	
Orient	: 0/+45/9	0.	Orient	Orient: 0/+45/90°		Orient: 0/+45/90°		
Spec. 1	io: <u>J22-8</u>		Spec. 1	No: J13-1	.0	Spec. No: 120-10		
Temp:	72°F(22	°C)	Temp:	72°F(2	(2°C)	Temp	72°F(2	(*C)
Stress	: 70.09 ks	i 60% ult.	Stress	70.09 (5	L <u>60</u> % wit.	Stress	70.09 ksi	60 tult.
Time	Accum. Strain (µ in/in)	Remarks	Time	Accum. Strain (#in/in)	Remarks	Time	Accum. Strain (µin/in)	Remark
0	5573		0	6030		0	6826	
0.017	5593		0.017	6053		0.017	6968	
0.10	5620		0.10	6074		0.10		
0.25	5627		0.25	6082		0.25		
0.50	5633		0.50	6088		0.50	6915	
1	5634		1	6094		1	6921	
2	5631		2	6097		2	6933	
3	5627		3	6094		3	6934	
68	5577		79	6079		24	6957	
170	565 5		170	5166		123	6988	
236	5673		236	6184	•	259	7028	
331	5688		331	6202		363	7056	
427	5663		427	6177		435	7070	
570	5691		571	6214		500	7080	
							<u> </u>	
!								
<u> </u>	<u> </u>	 					·	
<u> </u>								
	10			Pagaraga			Recovery	
	Recover			Recovery			-,4-0-019	_
<u> </u>	143	load off	0 5	207	load off	0	254	+
0.5	111	<u> </u>	0.5	164	1	0.5	217	 -
1 2	108 97	}	$-\frac{1}{2}$	155		 -}	207	+
3	92		3	140	L	5	192	

HyE 1076J Creep Test: Test: Creep Test: Creep 0/+45/90* Orient: 0/±45/90* Orient: 0/+45/90* Orient: Spec. No: 315-7 Spec. No: J16-9 Spec. No: 516-10 Temp: 260°F(127°C) Temp: 260°F(127°C) Temp: 260°F(127°C) Stress: 96.06 ksi 80 % ult. Stress: 96.06 ksi 80% ult. Stress 96.06 ksi 80% ult. Elap. Accum. Elap. Accum. Elap. Accum. Strain Remarks Time Strain Remarks Time Strain Remarks Time (Fin/in) (hrs.) (Min/in) (hrs.) (# in/in) (hrs.) 7702 6433 8159 0 0 0.017 7710 0.017 6435 0.017 8163 0.10 7694 0.10 6435 0.10 8170 0.25 7700 0.25 6425 0.25 8179 0.50 7692 0.50 6423 0.50 8181 7693 6415 1 8183 30 7654 100 6401 30 8203 100 7627 218 6411 100 3220 130.4 failed 6423 313 130.4 failed 493 6432 506 6436 Recovery Recovery Recovery -230 load off 0.5 -230 -204 -206 -182

Marketon and

HyE 1076J

Orient: 0/+45/90° Crient: 0/+45/90° Crient: 0/+45/90° Spec. No: 120-8 Spec. No: 121-1c Spec. No: 322-9 Temp: 260*F(127*c) Temp: 260*F(127*c) Temp: 260*F(127*c) Stress: 84.05 ksi 70* ult. Stress: 84.05 ksi 70* ult. Stress: 84.05 ksi 70* ult. Elap. Accum. Time Strain Remarks Remarks Flap. Accum. Time Strain (krs.) (kin/in) Strain (krs.) (kin/in) Remarks					HyE 1076	J			
Spec. No: 120-8 Spec. No: 121-1c Spec. No: 122-9	, -	Test: Creep Test: Creep					Test:	Creep	
Temp: 260*F(127*C) Stress: 84.05 ksi 70* ult. Elap. Accum. Time Strain (μ in/in) 0 6599 0.017 6599 0.017 7235 0.025 6593 0.059 7303 0.059 7306 0.059 7306 0.059 7306 0.059 7306 0.059 1 0.05 7306 0.059 1 0.05 7306 1 6595 1 1 7313 1 6451 3 6595 3 3 7308 4 6453 5 6593 5 7303 7 7291 5 6553 175 6553 7297 175 6553 7297 175 6553 7297 175 6553 7297 175 6553 7297 175 6553 7297 175 6553 7297 175 6553 7297 175 6553 7297 175 6553 7297 175 7287 175 6553 7297 175 7287 175 6553 7297 175 6553 7297 175 7287 175 6553 7297 175 7287	Orient	:0/±45/9	0°	Orient	Orient: 0/ <u>+</u> 45/90*		Orient: 0/+45/90°		
Stress: 84.05 ksi 70\$ ult. Stress: 84.05	1								
Elap. Accum. Time Strain (hrs.) (μin/in) 0 6599 0.017 7235 0.017 6459 0.025 7303 0.025 6455 0.050 6455 0.050 6455 0.050 6455 0.050 6455 0.050 6455 0.050 6455 0.050 6455 0.050 6455 0.050 6455 0.050 6455 0.050 6455 0.050 6455 0.050 6455 0.050 6455 0.050 6594 0.050 7306 0.050 6455 0.050	Temp:	Temp: 260°F(127°C) Temp: 260°F			260°F(1	27°C)	Temp:	260°F(1	2 <u>7°C)</u>
Time Strain Remarks (hrs.) (Stress	: 84.05 ks	i 70 % ult.	Stress	84.05 km	1 70 % ult.	Strass	<u>84.05</u> ksi	not ult.
(hrs.) (µin/in) 0 6599 0 0.017 6599 0 0.017 7235 0 0.017 6559 0 0.10 6559 0 0.10 6599 0 0.10 7303 0 0.25 6593 0 0.25 7303 0 0.50 6594 0 0.50 7306 0 0.50 6455 1 6593 1 7313 1 6451 3 6585 4 6584 4 7305 5 6583 5 7303 4 6453 79 6562 79 7291 175 7287 21 6443 22 46443 23 6564 412 7312 42 6564 507 6562 507 7307 508 6458 508 6458 508 6458 509 6435 509 6435 509 6435 509 6435 509 6443 509 6443 509 6443 509 6443 509 6443 509 6443 509 6443 509 6443 509 6458 500 7307 500					ŧ		,		
0 6599 0 0 7263 0 0 6450 0 0 0 6450 0 0 0 6450 0 0 0 0 6599 0 0 10 7290 0 10 6455 0 0 0 0 6455 0 0 0 0 0 6455 0 0 0 0 0 0 6455 0 0 0 0 0 0 6455 0 0 0 0 0 0 0 6455 0 0 0 0 0 0 0 6455 0 0 0 0 0 0 0 6455 0 0 0 0 0 0 0 6455 0 0 0 0 0 0 0 6455 0 0 0 0 0 0 0 0 6455 0 0 0 0 0 0 0 0 6455 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1		1	1	1		, -	1 -	1
0.017 6599				,					
0.10 6599 0.10 7290 0.10 6455 0.25 6593 0.25 6593 0.25 7303 0.25 6453 0.25 6453 0.50 6594 0.50 7306 0.50 6455 1 7313 1 6451 3 7308 2 6451 3 7308 3 6451 3 7308 3 6451 3 6451 3 7303 4 6453 6451 3 6 6439 3 6451 3 6 6439 3 6 6 6 6 6 6 6 6 6									
0.25 6593 0.25 7303 0.25 6453 0.50 6594 0.50 7306 0.50 6455 1 6451 1								6459	
0.50 6594 0.50 7306 0.50 5455 1 6595 1 7313 1 6651 3 6585 4 6584 4 7305 3 6451 5 6583 5 7303 4 6453 5 6563 79 6562 79 7291 5 6453 7312 96 6435 6451 6451 7312 73				0.10	7290		0.10	6455	
1 6595		6593		0.25	7303		0.25	6453	
3 6585 3 7308 2 6450 3 6451 5 6584 4 7305 3 6451 5 6583 5 7303 4 6453 79 7291 5 6453 79 7291 5 6453 7287 24 6443 7312 7312 7312 7312 7312 7312 7312 731	0.50	6594		0.50	7306		0.50	6455	
4 6584 4 7305 3 6451. 5 6583 5 7303 4 6453 79 79 7291 5 6453 779 7291 5 6453 79 7293 7312 96 6439 7312 7312 7312 7312 7312 7312 7312 7312	1	6595	<u></u>	1.	7313		1	6451	
5 6583 5 7303 4 6453 79 7291 5 6453 79 7291 5 6453 79 7291 72	3	6585		3	7308		2	6450	
79 6562 79 7291 5 6453 175 6553 175 7287 24 6443 293 6567 293 7312 96 6436 412 6564 412 7312 199 6428 507 6562 507 7307 7307 7307 6451 433 6475 504 6458 Recovery Recovery Recovery Recovery C 7 load off 1 -12 2 -55	4	6584		4	7305		3	6451	
175	5	6583		5	7303		4	6453	
293 7312 96 6436 412 6564 412 7312 199 6428 507 6562 507 7307 271 6432 433 6475 504 6458 Recovery Recovery Recovery C 7 load off 1 -54 2 -55 2 -56 3 -4 5 5 5 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6	79	6562		79	7291		5	6453	
### ##################################	175	6553		175	7287		24	5443	
507 5562 507 7307 271 6412 367 6451 443 6475 504 6458	293	6567		293	7312		96	6436	
Recovery C 7 load off 1 -54 2 -55 3 -66 3 -4 3 -66 3 -4 3 -66 3 -4 3 -67 5 -50 4 -6451 4.13 -6451 -54 -55 -50 -6451 -413 -6451 -54 -55 -50 -6451 -413 -6451 -54 -55 -50 -6451 -54 -55 -50 -6451 -54 -55 -50 -6451 -645 -6451 -645 -6451 -645 -645 -645 -645 -645 -645 -645 -645	412	6564		412	7312		199	642B	
Recovery Recovery	507	6562		507	7307		271	6432	
Recovery C 7 load off 1 -54 2 -55 3 -66 3 -4 3 -66 433 -6475 504 -6458							367	6451	
Recovery C 7 load off 1 -54 1 -12 0,5 -63 2 -55 2 -66 3 -4 2.5 -76								6475	
C 7 load off 0 30 load off 0 -40 load off 1 -54 1 -12 0.5 -63 2 -55 2 -6 1 -69 3 -66 3 -4 2.5 -76							504		
C 7 load off 0 30 load off 0 -40 load off 1 -54 1 -12 0.5 -63 2 -55 2 -6 1 -69 3 -66 3 -4 2.5 -76									
C 7 load off 0 30 load off 0 -40 load off 1 -54 1 -12 0.5 -63 2 -55 2 -6 1 -69 3 -66 3 -4 2.5 -76									
C 7 load off 0 30 load off 0 -40 load off 1 -54 1 -12 0.5 -63 2 -55 2 -6 1 -69 3 -66 3 -4 2.5 -76									
C 7 load off 0 30 load off 0 -40 load off 1 -54 1 -12 0.5 -63 2 -55 2 -6 1 -69 3 -66 3 -4 2.5 -76									
C 7 load off 0 30 load off 0 -40 load off 1 -54 1 -12 0.5 -63 2 -55 2 -6 1 -69 3 -66 3 -4 2.5 -76									
C 7 load off 0 30 load off 0 -40 load off 1 -54 1 -12 0.5 -63 2 -55 2 -6 1 -69 3 -66 3 -4 2.5 -76									
C 7 load off 0 30 load off 0 -40 load off 1 -54 1 -12 0.5 -63 2 -55 2 -6 1 -69 3 -66 3 -4 2.5 -76			}					1	
C 7 load off 0 30 load off 0 -40 load off 1 -54 1 -12 0.5 -63 2 -55 2 -6 1 -69 3 -66 3 -4 2.5 -76									
C 7 load off 0 30 load off 0 -40 load off 1 -54 1 -12 0.5 -63 2 -55 2 -6 1 -69 3 -66 3 -4 2.5 -76									
C 7 load off 0 30 load off 0 -40 load off 1 -54 1 -12 0.5 -63 2 -55 2 -6 1 -69 3 -66 3 -4 2.5 -76									
C 7 load off 0 30 load off 0 -40 load off 1 -54 1 -12 0.5 -63 2 -55 2 -6 1 -69 3 -66 3 -4 2.5 -76									
1 -54 1 -12 0.5 -63 2 -55 2 -6 1 -69 3 -66 3 -4 2.5 -76		Racover	7		Recovery			Recovery	
2 -55 2 - B 1 -69 3 -66 3 - 4 2.5 -76			load off			load off		7	load off
3 -66 3 -4 2.5 -76				-			1	1	
			<u> </u>		,			7 — — —	
3 -72	3	-66	<u></u>	3	- 4	<u> </u>			<u> </u>

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				HyE 1075	J			
Test				Cresp		Test:	Creep	
Orient	0/+45,/90	•	Orien	t: 0/±45/9	0*	Orient	0/+45/9	0.
Spec. N	ia:		Spec.	No: J14-	1.0	Spec. I	No: 314-	8
Temp:	260°F(1	27°C)	Temp	260°F(1	27°C)	Temp	260°F(1	27°C)
Stress	72.04 ks	i 60 % ult.	Stress	72.04	60% ult.	Stress	72.04	60 % ult.
Time	Accum. Strain (# in/in)	Remarks	Elap. Time (hrs.)	Strain	1 1	Time	Accum. Strain (µin/in)	Remarks
0	5521		0	6912		0	5877	
0.017	5525		0.017	6914		0.017	5884	
0-10	5539		0.10	7061		0.10	5881	
0.25	5544		0.25	7048		0.25	5881	
0.50	5554		0.50	7051		0-50	5884	
1	5561		1	7044	1	1	5880	
2	5561		2	7035		2	±875	
23	5569		23	7014		3	5871	
98	5589		98	7025		24	5860	
163	5601		163	7033		99	5859	
256	5628		266	7043		171	5860	
331	5637		331	7051		267	5868	
426	5654		426	7058		333	5875	
522	5671		522	7077		434	5984	
						500	5890	
								,
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					<u> </u>		<u> </u>	
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				!	<u> </u>	l	<u> </u>	
	Recover	У		Recovery	·		Recover	?
0	139	load off	0	45	load off		-9	load off
0.5	124		0.5	- 6	 	0.5	-28	
1	121		1_1_	-13	 	1	-33	
²	115		2	-20	<u> </u>	2	-43	<u> </u>

HyE 1076J

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Test	Creep		Test: Creep			Test: Creep		
-			Orient: 0/+45/90°					
1	0/+45/9						t: 0/+45/90	
l	io: J20-7		Spec. No: <u>J17-8</u>			Spec. No: <u>J21-7</u>		
Temp:	350°F(1	77°C)	Temp	350°F(1	77°C)	Temp	: 350°P(177	/ °C)
		i 80 % wit.	Stress	94.49 kg	808 ult.	Stres	Stress 94.49 ksi 80 t ult.	
	Accum.		Elap.		·	Elap.	Accum.	
Time		Remarks	Time		Remarks	f	5	Remarks
	(µ in/in)		(hrs.)	("in/in)		(hrs.)	(µin/in)	
0	7839	ļ	0	failed on	loading	0	8064	
0-017	7841					0.017	8064	
0.10	7842					0.10	8080	
J.25	7844					0.25	8084	
0.50	7856					0.50	8088	
1	7856					1	8086	
2	7868					52	8130	
3	7876					163	8178	
4	7880					234	8184	
5	7886					332	9204	
6	7902					402	8211	
24	7892					502	8220	
97	7657							
163	7667							
261	7675							
380	7791							
411	7823							
431	7834							
505	8048	,						
1								
Ī								
,,,, <u>,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,</u>	Recovery	,		Recovery			Recovery	
0	90	load off				0	O	load off
1	5					1	-53	
2	-13					2	76	
3	-44					3	-83	

Temp: 350°F(177°C) Stress: 82.68 ksi 70% ult. Elap. Accum. Time Strain Remarks (# in/in) (hrs.) 6601 ٥ 0.017 6634 0.10 6646 0.25 6650 0.50 6654 1 6666 2 6650 3 6646 24 6591 75 6648 31.5 7039 411 7076 500 7095 Recovery

321

0.5

load off

Creep

0/+45/90*

Test:

Orient:

Spec. No: 316-7

والمعاور عالم المنظمة المنظمة

Orient	Orient: 0/+45/90°				
Spec. I	Spec. No: <u>J17-7</u>				
Temp:	350°F(1	77°C)			
Stress	82.68 15	701 ult.			
Elap.	Accum.				
Time	Strain	Remarks			
(hrs.)	(#in/in)				
0	6217				
0.017	6227				
0.10	6231				
0.25	6245				
0.50	6270				
1	6300				
2	6318				
3	6318				
24	6554				
75	6739				
315	6872				
411	6992				
500	6894				
Recovery					
0.5	654 517	load off			
1	484				
	477				
3	462	······			

HyE 1076J Creep

Orien	Orient: 0/±45/90*					
Spec.	No: <u>J13</u> -	8				
Temp	350°F(177	*c)				
j	82.68 KS					
Elap.						
Time	Strain	Remarks				
(hrs.)	(µin/in)					
0	5475					
0.017	5499					
0.10	5568					
0.25	5657					
0.50	5692					
1	5706					
2	5733					
24	5946					
90	6147					
215	6206					
384	6,57					
521	6124					
		<u> </u>				
	<u></u>					
-						
-						
	<u> </u>					
	<u> </u>	-				
	Recovery					
0	97	load off				
0.5	19					
1	12	1				
2	12					
3	3					

Test:

Creap

Test: Creep Orient:_ 0/+45/90* Spec. No: J15-9 Temp: 350°F(177°C) Stress: 70.87 ksi 60 % ult. Elap. Accum. Remarks Time Strain (hrs.) (# in/in) ø 4960 0.017 4995 0.10 5004 0.25 5019 0.50 4911 4927 1 3 4963 4 4978 4995 5011 6 24 5214 99 5396 196 5423 294 5424 5421 362 431 5414 504 5394 Recovery 231 load off. 0.5 220 193 187

_	Hye 1076J					
Test:_	Test: Creep					
Orient	: 0/+45/9	io•				
Spec. 1	No: <u>J22-</u> 1	0				
Temp	350°F(17	7°C)				
San Property and P	70.87 1	60 Wt.				
Elap.	Accum.					
Time	Strain	Remarks				
	(#in/in)					
	5959					
0.017	5979					
0.10	6004					
0.25	6008					
0.50	6528					
1	6562					
3	6580					
4	6584					
5	6586					
6	6587					
24	6659					
99	6978					
196	7205					
294	7328					
362	7373					
431	7403					
504	7398					
	Recovery					
0	797	load off				
0.5	718					
3	673					
1_1_	652	L				

rear crear							
Orient	: 0/+45/90	<u>· </u>					
Spec. 1	Spec. No: <u>J20-9</u>						
1	350°P/1	1					
1	70.87 ksi	1					
-	Accum.						
Time	Strain	Remarks					
(hrs.)	(µin/in)						
0	5489	,					
0.017	5491						
0.10	5500						
0.25	5490						
0.50	5483						
1	5476	i					
3	5457						
4	5457						
6	5458						
25	5475						
148	5779						
267	5839						
364	5862	<u> </u>					
462	5877						
527	5877						
	·						
-							
							
 							
 		İ					
	Racovery						
3	327	load off					
0.5	298						
1	295						
2	28€	2					
4	278						

Test:

Creep

6535~1

DVIZAMENCE

				6535~1		
Test:	Creeu		Test:	Creep		Test:
Orient	+45*		Orient	: <u>+4</u> 5*		Orien
Spec. 1	No: K4-9		Spec.	No: K8-8	<u> </u>	Spec.
Temp:	72*F{2	:*c)	Temp	72*1(2	2°C)	Temp
Stress	: 13.22 ks	ú <u>80</u> \$ ult.	Stress	13.22 ks	i_80% ult.	Stres
Elap.	Accum.		Elap.	Accum.		Elap.
Time	,	Remarks	Time	Strain	Remarks	Time
(hrs.)	(# in/in)		(hrs.)	(Pin/in)		(hrs.)
0	4932		0	4968		0
0.017	5134		0.017	5107		0.015
0.10	5357		0.10	5347		0.10
0.25	5486		0.25	5468		0.25
0.50	5601		0.50	5590		0.50
1	5718		1	5706		1
2	5840		2	5828		2
3	5910		3	5900		3
43	6406		43	6439		43
218	6878		218	6965		218
335	7062		335	7170		335
431	7170		431	7289		431
504	7244		504	7366		504
-						
						<u> </u>
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			ļ			
			ļ			
						ļ
					!	ļ
<u></u>	Recover			Recovery		
0	2232	load off	00	2258	load off	0
0.5	166°		0.5	1668	<u> </u>	0.5
1 2	1562		1	1557		1
<u> </u>	1454	L	2	1448	L	2

Test:	Creep						
Orien	:: +45*						
Spec.	No: KI	1-8					
Temp	72°F(22	*c)					
Stress	13.22 ksi	_ant uit.					
Elap.	Accum.						
Time	Strain	Remarks					
(hrs.)	(µin/in)						
0	548R						
0.015	5580						
0.10	5910						
0.25	6048						
0.50	6198						
1	6337						
2	6485						
3	6 56 9						
43	7186						
218	7800						
335	8041						
431	3180						
504	8269						
ļ							
	Recovery						
		load off					
-	2003						
	1867						
2	1736	<u> </u>					

Test: Creep Test: +45. Orient: Spec. No: K8-6 Temp: 72°F(22°C) Stress: 11.57 ksi 70 % ult. Elap. Accum. Time Strain Remarks (Fin/in) (hrs.) 4246 0.017 4496 0.10 4626 0.25 4731 0.50 4831 4890 4968 5029 25 5316 5562 91 194 5772 5874 267 351 6015 434 6101 503 6160 Recovery 1530 load off 0 0.5 1038 958 901

858

±45° Orient: Spec. No: K10-9 72°F(22°C) Temp: Stress: 11.57 ksi 70% ult. Elap. Accum. Time Strain Remarks (hrs.) (Hin/in) 4456 0.017 4627 0.10 4784 0.25 4897 0.50 5010 5076 5165 5232 25 5555 91 5828 194 6089 267 6214 351 6371 434 6465 503 6535 Recovery 1757 load off 0 0.5 1200 1 1107 1050 1000

6535-1

Creap

Test: Cresp ±45° Orient: Spec. No: K11-6 Temp: 72°F(22°C) Stress 11.57 ksi 70 % ult. Elap. Accum. Time Strain Remarks (µin/in) (hrs.) 0 4582 0.017 4690 4872 0.10 0.25 4977 0.50 5097 5159 1 2 5250 5315 25 5639 91 194 6146 267 6258 6407 434 6500 6572 Recovery 0 1885 load off 0.5 1265

2

6535~1

With the second

Test: Creep Test: Creep Test: Creep <u>+</u>45° ±45° Orient: +45° Orient: Orient: Spec. No: K3-2 Spec. No: K3-3 Spec. No: K3-4 72°F(22°C) Temp: 72°F(22°C) Temp: Temp: 72°F(22°C) Stress: 9.92 ksi 60 % ult. Stress: 9.92 ksi 60 % ult. Stress 9.93 ksi 60 ult. Elap. Accum. Elap. Accum. Elap. Accum. Time Strain Remarks Time Strain Remarks Time Strain Remarks (# in/in) (µin/in) (Pin/in) (hrs.) (hrs.) 3417 0 3310 0 3528 0.017 3550 0.017 3399 0.017 3626 0.10 3632 0.10 3466 0.10 3700 0.25 3700 0.25 3520 0.25 3767 0.50 3764 0.50 3572 0.50 3832 1 3803 3607 3872 3858 3650 3 3927 4 3884 3674 4 4 3954 5 3966 5 3748 4034 47 4188 47 3939 47 4267 195 4373 195 4108 222 4390 222 4120 222 4468 312 4490 312 4205 312 4565 456 4584 456 4286 456 4660 502 4610 502 4327 502 4690 Recovery Recovery Recovery 0 1224 C load off ٥ 1059 1177 load off load off 918 0.5 83.5 900 868 1 756 851 799 2 697 2 784 725 646

Test:	Creep		Test:	Creep		Test:	Creep	
Orient	±45°		Orient: 45°		Orient	Orient: +45°		
Spec. 1	io:K6~8		Spec. !	No: 16-9		Spec.	Spec. No: K6-10	
Temp:	260°F(1	27°C)	Temp	260°F(27°C)	Temp	260°F(1	27°C)
Stress	: 12.45 ks	i 80 % ult.	Stress	12.45 ys	80 % ult.	Stress	12.45 ksi	80 t ult.
Elap.	Accum.		Elap.	, -, , ,		Elap.		
Time		Remarks	Time	Strain	Remarks	Time		Remarks
0	(µ in/in) 5213		(hrs.)	(#im/im) 6456		(hrs.)	5197	
0.017	5656		0.017	7148		0.017	5484	
0.10	6094		0.10	7743		0.10	6131	
0.25	6369		0.25	8148		0.15	6330	
0.50	6567		0.50	8610		0.25		
1	6783		1	9021		1	6514	
2	6981		2	9719		2	6696	
3	7173		4	10429		4	6979	
43	8472		5	10648			7339	
253	12829		7	10976		<u>5</u> 7	7458 7647	
308	qaqe fa	i 1-d	24	12702		24	8606	
500	no fail		43	gage fa	led	54	failure	
			500	no fail			7-22-0-20	
						ļ		<u> </u>
						 		
				 	<u> </u>			
			 				<u> </u>	
						 	 	
				 	 			
	P			T	<u>!</u>	 	Recovery	<u> </u>
ļ	Recover	7		Recovery			wacnast)	
				 		\		
				<u> </u>		 	<u> </u>	
				 		 		

Tess:_	Creep	
Orient	<u>+45°</u>	
Spec. 1	io: K4-8	
Temp:	260°F(12	7°C)
Stress	: 10.89 Kg	i_70 % ult.
Elap,	Accum.	
Time		Remarks
(hrs.)	(# in/in)	
0	4549	
0.017	4944	
0.10	5192	
0.25	5364	
0.50	5440	
1.5	\$607	
2.5	5670	
3	5704	
5	5806	
7	5872	
8	5880	
24	6113	
127	6569	
223	6803	
342	7016	
459	7201	
508	7275	
	Recover	
0	2863	
0.5	2333	load off
1	2179	
2	2077	
	h	

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6535-1								
Test: Creep								
Orient: ±45*								
Spec. 1	No: E7-10							
Temp:	260°F()	27°C)						
	10.89 km	70 t ult.						
Elap.	Accum							
Time	Strain	Remarks						
(hrs.)	(#in/in)							
C	5382							
0.017	5673							
0.10	5993							
0.25	6147							
0.50	6347							
1	6536							
6	71.22							
7	7175							
69	8557							
174	9594							
246	10348							
339	11644							
414	14254							
431	failed							
		Park - 100 -						
		l						
	Recovery	y						
l								

Orient	Orient: +45°							
Spec.	Spec. No: K10-7							
Temp	250°F(1	27°C1						
Strass	10.89 ksi	. 70% ult.						
Elap.	Accum.							
Time	Strain	Remarks						
(hrs.)	(µin/in)	·						
0	4734							
0.017	4925							
0.10	5413							
0.25	5730							
0.50	5830							
1.5	6025							
2.5	6121							
3	6154							
5	5274							
7	6363							
8	6389							
24	6703							
127	7477							
223	7919							
342	8385							
459	8722							
50e	8857							
		 						
		 						
		 						
		}						
	<u> </u>	L						
! 	Recovery							
0	4543	load off						
0.5	4029							
1	3861	<u> </u>						
2	3727	<u> </u>						

Tess:

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				6535-1				
	Creep			Creep		Test:	Creep	
Orient	<u>+45°</u>		Orient	: ±45°		Orient	±45°	
	No: K4-10		Spec.	No: K10-8		Spec.	No: K10-10	j
Temp:	260°F(12	7°C)	Temp	260°F'(12	7°C)	Temp	260°F(]	.27°C)
Stress	: 9.44 ks	i 60 % ult.	Stress	9.44 kg	i 60 % ult.	Stress	9.44 isi	60 tult.
Time	Accum. Strain (# in/in)	Remarks	Time	Accum. Strain (#in/in)	Remarks	Time	Accum. Strain (µin/in)	Remarks
0	3405		0	3346		0	3630	
0.017	3597		0.017	3507		0.017		
0.10	3719		0.10	3635		C.10		
0.25	3898		0.25	3771		0.25		
0.50	3929		0.50	3915		0.50	4178	
1	3996		1	3921		1	4315	
3	4129		3	4080		3	4522	
4	4173		4	4126		4	4595	
73	4667		73	4746		73	5473	
170	4890		170	5078		170	5889	
245	5008		245	5222		245	6125	
337	5141		337	5403		337	6435	
458	5282		458	5597		458	6801	
504	5315		504	5652		504	6975	
	Recover	У		Recovery			Recovery	
0	1714	load off	a	2173	load off	0	4211	load off
0.5	1623		0.5	2052		0.5	4059	·
<u></u>	1577		1	1998			4054	
2	1515	<u>i </u>		1953	<u> </u>	2	4049	<u>i — — — — — — — — — — — — — — — — — — —</u>

Test:	Creep								
Orient: +45°									
Spec. N	Spec. No: K3-1								
Temp:	350°F(17	7°C)							
Stress	11.54	i 70 % tilt.							
Elap.	Accum.								
Time	Strain	Remarks							
(hrs.)	(# in/in)								
0	5574								
0.017	6329								
0.10	7338								
0.25	8092								
0.50	8571								
ı	9198								
2	9869								
3	10402								
5.5	11136								
7	11456								
8	11687								
31,	14284								
79	16567								
144	18440								
247	20764								
315	22307								
415	23965								
504	25513								
									
	Recover	y							
0	20250	load off							
0.5	17465								
1	16962								
5	16385 15865	L)							
>	12862								

Test: Creep Orient: +45° Spec. No: K5-7 Temp: 350°F(177°C) Stress: 11.54 ksi 70 % ult. Elap. Accurn. Time Strain Remarks (hrs.) (βin/in) 0 7114 0.017 7665 0.10 8900 0.25 qaqe falled 504 no failure Recovery		9232-1								
Spec. No: KS-7 Temp: 350°F(177°C) Stress: 11.54 kgi 70 tult.	Test: Creep									
Temp: 350°F(177°C) Stress: 11.54 kmi 70 % ult. Elap. Accum. Time Strain (hms.) (μin/in) 0 7114 0.017 7665 0.10 8900 0.25 gare failed 504 no failure		Orient: +45°								
Stress: 11.54 kmi 70 % ult. Elap. Accurn. Time Strain (μin/in) 0 7114 0.017 7665 0.10 8900 0.25 qaqe failed 504 no failure	Spec. 1	No: X5-7								
Elap. Accum. Time Strain (hrs.) (#in/in) 0 7114 0.017 7665 0.10 8900 0.25 gage failed 504 no failure	Temp:	350°F(17	7°C)							
Time (hrs.) (µin/in) 0 7114 0.017 7665 0.10 8900 0.25 gage failed 504 no failure	Strees	11.54 18	<u>70</u> 1 ult.							
Time (hrs.) (µin/in) 0 7114 0.017 7665 0.10 8900 0.25 gage failed 504 no failure	Elap.	Accum.								
0 7114	Time	Strain	Remarks							
0 7114	(hrs.)	(Pin/in)								
0.017 766S 0.10 8900 0.25 gage failed 504 no failure		7114	-							
0.25 gage failed 504 no failure		7665								
0.25 gage failed 504 no failbre	0.10	8900								
504 no failure		gage fa	iled							
Recovery	7.7.7		-							
Recovery										
Recovery										
Recovery										
Recovery										
Recovery										
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Test: Creep								
Orien	Orient: ±45°							
	Spec. No: K5-8							
Temp	350°F(17	7°C)						
Stress	11.54 161							
Elap.	Accum							
Time	Strain	Remarks						
(hrs.)	(µin/in)							
C	6705							
0.017	7090							
0.10	7904							
0.25	12756							
0.50	19949							
1	24217							
2	gage fa	iled						
504	no fai	lure						
								
		<u> </u>						
 								
	 							
	·							
	Recovery							
		 						
		 						
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Test: Creep Creep Test: Orient: +45° <u>+</u>45° Orient: Spec. No: K7-8 Spec. No: K8-7 Temp: 350°F(177°C) 350°F(177°C) Temp: Stress: 9.89 ksi 60 % ult. Stxess: 9.89 ksi60 t ult. Accum. Elap. Accum. Elap. Time Strain Remarks Remarks Strain Time (Fin/in) (hrs.) (# in/in (hrs.) 5374 0 5513 0 0.017 5646 5895 0.017 0.10 71.78 0.10 7346 7923 0.25 7906 0.25 0.50 8628 8631 0.50 1 9411 9386 1 2 10321 2 10357 11987 11626 79 21383 79 18644 174 25911 174 22616 28046 247 247 24250 343 30486 3 43 26175 414 32217 27291 414 gage failed 508 28737 508 Recovery Recovery 24736 load off 0 23938 0.5 23579 23429 2

Test:	Creep							
Orient: +45°								
Spec. No: K9-9								
Temp:	350°F(1	77°C)						
Stress_9	.89 ksi	60 ult.						
	cum.							
Time Si (hrs.) (µ	rain	Remarks						
	in/in)							
0	6794							
0.017	7194							
0.10	7 7 92							
0.25	8235	**************************************						
0.50	14336		Ì					
1	14763							
	14859							
5	gage fi		ļ					
508	no fai	lure	l					
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R	ecover.	7	7					
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			€	535-1				
Test:	Creep		Test:	Creep		Test:	Creep	
Orient	±45°		Orient	±45°		Orien	:: <u>+</u> 45°	
Spec. 1	lo: K11-7		Spec. 1	No: K7-9		Spec.	No: K9-10	
Temp:	350°F(17	7°C)	Temp:	350°F(17	7°C)	Temp	330°F(17	7*21
Stress	8.24 ks	1_50 % ult.	Stress	8.24	i_50% ult.	Stress	8.24 15	50 t ult.
Elap. Time (hrs.)	Accum. Strain (µ in/in)	Remarks	Elap. Time (hrs.)	Accum. Strain (#in/in)	Remarks	Elap. Time (hrs.)		Remarks
0	3668		Specime	n overheat	d before	Spec	imen Kailed	on
0.017	3954			was run.			loading.	
0.10	4738							
0.25	5258							
0.50	5670							
1	6148							
3	7073							
4	7474							
.73	14048							
170	16375							
215	17577							
263	17850							
337	18891							
458	20324							
504	21020							,
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	7	<u> </u>		<u> </u>		 	Page 222	<u></u>
	Recover			Recovery	T		Recovery	T
0	17993	load off		ļ		<u> </u>		
0.5	17430						 	
1	17275			 	-		 	
2	17124	<u> </u>	l	<u> </u>	L	l	<u> </u>	

Tast: Creep Test: Creep			Test: Creep					
Orient: See below		Orient: See below Orient: See below			Low			
Spec. N	To: K24~4		Spec.	No: x26	-2	ŧ	No: K24-	
Lemb:	72°F(22°C)	Temp	72°F(2	2°C)	Temp	72°F(22°	C)
Stress	: 72.70 ks	<u>1 80 % ult.</u>	Strans	72.70 E	1.80 % ult.	Stress		80 tult.
Elap.	Accum.			Accum.		Elap.	Accum.	
Time	Strain	Remarks	Time		Remarks	Time		Remark
	$(\mu \text{ in/in})$		(prs.)	(Pin/in)		(hrs.)	(µin/in)	
0	6278		0	failure o	n loading	0	6353	
-017	6302					0.017	6380	
0.10	6316					0.10	6401	
0.25	6323					0.25	6410	
0.50	6327					0.50	6418	
1	6330					1	6423	
3	6335					2	6428	
5	6335					25	6452	·
6	6335					91	6478	
71	6366					194	6490	
175	6382					260	6514	
240	6404					362	6511	
342	6399					427	6534	
406	6420					501	6532	
502	6426		-			301	6535	
						-	·	
								
								
		 						
		 		 				
		 		 				
				 	 			
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		 	<u></u>	}				
								-
				<u> </u>				
	R ecover	7		Recovery			Recovery	•
0	158	load off				0	237	load off
0.5	122	1				0.5	193	
Ĭ.	115					1	188	
2	102					3	193	
[A		-45,+45,0,90,6				1-4	1.77	

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			6535-1 Test: Creen				
	Creep		Test:_	Creen			
Orient	: See belo		Orient: See below				
Spec. No: K25-5 Temp: 72°F(22°C)			Spec. No: K25-3				
			Temp:	72°F (22°C)		
Stress	63.62 ks	i 708 ule.	Stress:	63.62 kg	1 70		
Elap. Time (hrs.)	Accum. Strain (# in/in)	Remarks	Elap. Time (hrs.)	Accum. Strain (Fin/in)	Remarks		
0	5346		0	5408			
.017	5364		0.017	5431			
0.10	5387		0.10	5454			
0.25	5394		0.25	5458 5458			
0.50	\$400		0.50	5459			
1	5400		1	5461			
3	5406		2	5458			
4	5405	7.	4	5457			
5	5406		5	5452			
6	5405		7	5449			
24	5422		24	5465			
54	5420		\$ 5	5453			
119	5444		120	5468			
221	5456		222	5475			
335	5484		336	5497			
455	5489		456	5503			
503	5482		504	5496			
	1				 		
	<u> </u>						
			<u> </u>		 		
*	-						
-					 		
	Recover	<u>'</u>		Recovery			
0	140	load off	0	90	load off		
9.5	107		0.5	70			
1	100		1	64			
2	90		2	57			
4	83 0,+45,-45,0		4	56	1		

Test: Creep									
Orient: See below									
Spec. No: K26-8									
Temp	Temp: 72°F(22°C)								
Stress	Stress 63.62 kgi 70 ult.								
Elap.	Accum.								
Time	Strain	Remarks							
(hrs.)	(µin/in)								
0	52B6	<u></u>							
0.017	5295								
0.10	5450								
0.25	5455								
0.50	5457								
1	5457								
2	5454								
4	5453								
5	5452								
7	5449								
24	5463								
55	5456								
1.20	5473								
222	5484								
336	5505								
456	5510								
504	5505								
	Recovery								
0	167	load off							
0.5	142								
1	136								
_2	126								
4	123								

6535~1

				6535~1				
·	Creep		Test:	Creen		Test:	Creep	
Orient	Orient: See below Orient: See be			low	Orient: See below			
Spec. 1	4o: <u>x35-</u> 2		Spec.	No: <u>K36-</u>	4	ăpec.	No: <u>K34-</u>	
Temp:	72°F(22	(°C)	Temp	72°7(2	2°C)	Temp	72°F(22	(c)
Stress	: 73.22 to	i 80% ult.	Stress	73.22	1 80 % wit.	Storess	73.22	801 ult.
Elap.	ł .			Accum.		:	Accum	
Time		Remarks	Time		Remarks	Time		Remarks
	(# in/in)			(Pin/in)		(bre.)		
0	6413		0	failure	n loading	0	6523	
0.017	6435					0.017	6546	
0.10	6456					0.10	65 66	سان دروارد المسهورات الم
0.25	6466		-		•	0.25	6578	
0.50	6470				<u></u>	0.50	6582	
1	6472					1	6597	
2	6476					3	6592	
3	6478					4	6591 ←	
25	6499					5	6591	
98	6518					5	6590	
171	6519					24	6617	
267	6472					100	6624	
338	6465					270	6577	
434	6466					341	6581	
552	6482					437	6594	
						506	6597	
	Rocaver	7		Recovery			Recovery	,
0	126	load off				0	136	load off
0.5	73			 	 	0.5	72	
1	59			-	 	 	63	-
2	56		ļ	 		2	57	}
	7 30		L	<u> </u>	<u> </u>	3	52	<u> </u>

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				6535-1					
Test:	Creep		Test:	Creep		Test:	Craep		
Orient: See below			Orient	See be	low	Orient: Sae below			
Spec. N	c. No: 134-7 Spec. No: K35-10						No: <u>кзк</u> ~	6	
Temp: 72°F(22°C) Temp: 72°F(22°C)					°C)	1	72°F(2		
Stream	64.07 ks	170 5 plt.	Storens	64.07	i_703 ult.	Storess	64.07 103	70 % olt.	
Elap. Time (hrs.)	Accum. Strain (µ in/in)	Remarks	Elap. Time (hrs.)	Accum. Strain (Fin/in)	Remarks	Elap. Time (hrs.)	Accum. Strain (µin/in)	Romask	
0	5596		е	5717		0	56.04		
0.017	5614		0.017	5746		0.017	5782		
0.10	5632		0.10	5767		0.10	5816		
0.25	5642		0.25	5780		0.25	5826		
0.50	5650		0.50	5786		0.50	5833		
1	5653		1	5792		1	5839		
2	5658		2	5797		2	5844		
4	5670		4	5808		4	5852		
5	5664		5	5806		5	5852		
7	5664		7	5802		7	5848		
25	5683		30	5818		30	5862		
103	5686		103	5828		103	5972		
271	5710		271	5851		271	5897		
367	5704		367	5836		367	5882		
438	5706		438	5837		438	5884		
510	5707		510	5838		510	5885		
	Recover	y		Recovery			Recovery		
О	60	load off	0	94	losd off	0	137	load off	
0.5	31		0.5	53		0.5	-90		
1	25		1	97			80		
2	21		2	40	<u> </u>	2	25	<u></u>	

Test:_	Creep		Test:	Creep		Test:	Creep		
Orient: See below Spec. No: K38-4			Orient	See b	elow	Orient: See below			
			Spec.	No: <u>K39-5</u>		Spec.	No: <u>k37-</u>	.0	
Temp:	72°F(22°	(c)	Temp	72°F(22°	<u> </u>	Temp	72°F(22'	°C1	
Stress	: 77.83 kd	i 30 % wit.	Stress	77.83 kd	. 80 6 ult.	Street	77.83 XSI	80 t ult.	
Elap.	Accum.		Elap.	Accum.		Elap.	Accum.		
Time	Struin	Remarks	Time	Strain	Remarks	Time	Strain	Remark	
(hrs.)			(hrs.)			(pra.)	(uin/in)		
0	6404		0	failure	n loading	0	6488		
-017	6422					0.017	6506		
0.10	6437					0.10	6522		
0.25	6443					0.25	6530		
0.50	6448					0.50	6537		
1	6453					1	6542		
2	6460						6552		
3	6456					4	6556		
48	6482					5	6556		
125	6492					51	6579		
219	6501					127	6592		
265	6475					222	660 6		
46L	6482					342	6583		
487	6502					464	6588		
506	6462					481	6606		
						505	6574		
							والمساورة والمساورة		
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							الأوارات ويهرب الموادق عودا		
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							Accession . Spring all tools w		
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				1					
	Recover	y		Recovery	-		Recovery		
0	73	load off					117	*****	
0.5	39			<u> </u>		0.5	60	!	
1	39						56		
2	39		l	1	1	2	60	<u></u>	

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Test: Test: Creso Creep Orient: See below See below Orient: Spec. No: K38-7 Spec. No: k39-3 Temp: 72°F(22°C) Temp: 72°P(22°C) Strues: 68.10 1st 70 t ult. Stress: 68.10 ksi 70 t ult. Elap. Elap. Accum Accum. Time Strain Remarks Time Strain Remarks (# in/in) (#in/in) (hrs.) (hrs.) 0 5746 5406 0.017 5765 0.017 5565 0.10 5778 0.10 5574 0.25 5783 0.25 5579 0.50 5788 0.50 5585 3 5794 5590 5799 2 5590 2 5799 5590 5816 71 5588 167 5826 167 5596 243 5838 243 5607 338 5844 338 5610 408 5821 408 5590 503 5834 503 5600 Recovery Recovery load off o 71 0 60 load off 32 2 26 18

Test:	Creep						
Orient: See below							
Spec. No: <u>K37-5</u>							
Temp	72°F(22°	c)					
Stress	68.10 ksti	70 ult.					
Elap.		,					
Time	Strain (µin/in)	Remarks					
(hrs.)	(µin/in)						
0	581)						
0.017	5819						
0.10	5833						
0.25	5841						
0.50	5848						
1	5854						
2	5859						
3	5862						
71	5880						
167	5 88 9						
243	5901						
338	5909						
408	5684						
503	5894						
	!						
	Recovery						
0	114	load off					
0.5	86						
1 2	78						
2	70						

[0,90,+45,-45,0,0,-45,+45,0,0]s

APPENDIX K THERMAL EXPANSION DATA

All of the thermal expansion data generated during this program are presented in this appendix. In addition, a typical thermal expansion curve is included at the end of the section. The procedure for computing coefficient of thermal expansion from such a curve is detailed in Paragraph 3.5.10. These data are summarized in Paragraphs 4.1 through 4.6.

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Test: Coefficient of Thermal Expansion Materials: Aluminum Standard							
Specimen Number	Fiber	Temp. Range	Coeff. Therm. Expansion (10 ⁻⁶ in/in-°F)	Variation from Litera-			
		50	11,59	4.48			
		212	12.29	6.28			
		392	13.00	4.5%			
· · · · · · · · · · · · · · · · · · ·		572	13.16	7.1%			
This al	minum s	candard	and its a values,	was supplied by			
Perkin :	Elmer, b	it is no	traceable to NB	5.			

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pecimen Number	Fiber Orien- tation	Temp. Range (°F)	Coeff. Therm. Expansion (10-6in/in-°F)	Remarks
7B1-5	0.0	-67	-0.083	
B2-6	0°	-67	-0.036	
*B3-3	0.	-67	-0.135	
lvg.			-0.085	
FB1-7	0°	72	-0.358	
B2-4	0°	72	-0.352	
B3-4	0°	72	-0.403	
Avg.			-0.371	
7B1-1	0°	260	-0.130	
FB2-1	0°	260	-0.125	
FB3-1	0°	260	-0.155	······································
Avg.			-0.137	
FB1-4	0.	350	-0.109	
FB2-2	0°	350	-0.327	
FB3-2	0.	350	-0.170	
Avg.			-0.202	
FA1-6	90°	-67	12.18	
FA1-8	900	-67	11.96	
FA2-4	90°	-67	14.47	
Avg.			12.37	
FAL-7	90°	72	13.60	
FA1-9	90°	72	13.32	
FA2-5	90°	72	13.72	
lvg.			13.55	

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Test: Coefficient of Thermal Expansion Materials: T300/AFR800							
Specimen Number	Fiber	Temp. Range (°F)	Coeff. Therm. Expansion (10-6in/in-°F)	Remarks			
FA1-1	90°	260	12.85				
FAl-3	90°	260	14.79				
FA2-3	90°	260	15.70				
Avg.			14.45				
FA1-2	90°	350	17.03				
FAl-5	90°	350	17.38				
FA2-2	90°	350	16.31				
A v g.			16.91				
FC1-3	±45°	-67	2.378				
FC2-3	±45°	-67	2.905				
FC3-3	±45°	-67	2.599				
Avg.			2.627				
FC1-4	±45°	72	2.440				
FC2-4	±45°	72	2.732				
FC3-4	±45°	72	2.171				
Avg.			2.448				
FC1-1	±45°	260	2.939				
FC2-1	±45°	260	2.988				
FC3-1	±45°	260	2.508				
Avg.	/		2.312				
FC1-2	±45°	350	3.416				
FC2-2	±45°	350	3.529	<u> </u>			
FC3-2	±45°	350	2.768				
Avg.			3.238				

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pecimen Number	Fiber Orien- tation	Temp. Range (°F)	Coeff. Therm. Expansion (10-0in/in-°F)	Remarks
Glo-A	0.4	-67	1.38	
GlO-B	0.	-67	1.34	
GlO-C	0.	-67	1.29	
Avg.			1.34	
G10-A	0°	72	1.28	
G10-3	0*	72	1.52	
G10-C	0.	72	1.47	
Avg.			1.56	
G10-A	0.0	260	2.34	
G10-B	0°	260	1.76	
G10-C	0°	260	1.92	
Aγg.			2.01	
G10-A	0.0	350	2.70	
G10-B	0°	350	2.12	
G10-C	0.0	350	1.88	
Avg.			2.23	
G10-D	90°	-67	7.78	,
G1.0-1:	900	-67	8.11	
G10-F	90°	-67	7.73	
Avg.			7.89	
Gle-D	90°	72	9.61	
G10-E	900	72	9.67	
G10-5	90°	72	9.39	
Avg.			9.56	
		,,2		

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Specimen Number	Piber Orien- tation	Temp. Range (°F)	Coeff. Therm. Expansion (10 ⁻⁶ in/in-°F)	Remarks
GlO-D	90°	260	19.4	
G10-E	90°	260	20.2	
GlO-F	90°	260	16.9	
Avg.			18.8	
G10-D	90°	350	38.2	
GlO-E	90°	350	41.4	
G10-F	90°	350	33.9	
Avg.			37.8	
G15-A	±45°	-67	2.86	
G15-B	±45°	-67	2.92	
G17-A	±45°	-67	2.73	
Avg.			2.83	
G15-A	±45°	72	3.31	
G15-B	±45°	72	3.47	
G17-A	±45°	72	3.22	
Avg.			3.33	
G15-A	±45°	260	3.56	
G15-B	±45°	260	4.10	
G17-C	±45°	260	2.89	
Avg.			3.52	
G15-A	±45°	350	4.12	
G15-B	±45°	350	5.14	
G17-A	±45°	350	2.94	
Avg.			4.07	

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Specimen Number	Fiber Orien- tation	Temp. Range (°F)	Coeff. Therm. Expansion (10 ⁻⁶ in/in-°F)	Remarks
H32-2	0°	-67	-1.00	
H32-3	0°	- 67	-1.29	
н32-1	0°	-67	-1.38	
Avg.			-1,22	
н32-2	0°	72	-1.55	
H32-3	0.0	72	-1.36	
H32-1	0.	72	-1.70	
Avg.			-1.54	
H32-1	0°	260	-1.62	
н32-2	0°	260	-1.65	
H32-3	0°	260	-1.57	
Avg.			-1.61	
H32-1	0°	350	-1.43	
H32-2	0°	350	-1.92	
н32-3	0.	350	-2.48	
Avg.			-1.94	
H32-4	90°	-67	26.5	
H32-5	90°	-67	26.6	
н32-6	90°	-67	28.2	
Avg.			27.1	
н32-4	90°	72	32.0	
H32-5	90°	72	29.6	
н32-6	90°	72	30.3	
Avg.			30.6	
	 			
	 			

Test: Coefficient of Thermal Expansion								
	Materials: HyE 2034D							
Specimen Number	Fiber Orien- tation	Temp. Range (°F)	Coeff. Therm. Expansion (10 ⁻⁶ in/in-°F)	Remarks				
H32-4	90°	260	39.4					
H32-5	90°	260 `	37.1					
н32-6	90°	260	42.2					
Avg.			39.6					
H32-4	900	350	58.7					
H32-5	90°	350	54.7					
H32-6	90°	350	59.9					
Avg.			57.8					
н34-1	45°	-67	-0.463					
H34-2	45°	-67	-0.320					
H34-3	45°	-67	-0.0127					
Avg.			-0.265					
н34-1	45°	72	-0.517					
H34-2	45°	72	-0.475					
H34-3	45°	72	-0.221					
Avg.			-0.404					
н34-1	45°	260	-0.557					
н34-2	45°	260	-0.694					
н34-3	45°	260	-0.662					
Avg.			-0.638					
н34-1	45°	350	-0.674					
н34-2	45°	350	-0.923					
н34-3	45°	350	-1.06					
Avg.			-0.886					
)					

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Specimen Number	Fiber Orien- tation	Temp. Range (°F)	Coeff. Therm. Expansion (10-6in/in-°F)	Remarks
143-1	0°	-67	0.145	
143-2	0°	-67	0.099	
143-3	0.0	-67	0.415	
Avg.			0.217	
143-1	00	72	-0.101	
143-2	00	72	-0.162	
143-3	0°	72	-0.556	
Avg.			-0.273	
143-1	0.0	350	-0.108	
143-2	ပ္ပံစ	350	-0.219	
143-3	0°	350	-0.281	
Avg.			-0.203	
143-1	0°	450	-0.148	
I43-2	0°	450	-0.217	
143-3	0°	450	-0.370	
Avg.			-0.245	
144-1	45°	-67	4.27	
144-2	45°	-67	3.80	
I44-3	45°	-67	3.86	
Avg.			3.98	
144-1	45°	72	2.96	
144-2	45°	72	2.84	
144-3	45°	72	3.12	
Avg.			2.97	
	 			

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Test: Coefficient of Thermal Expansion Materials: T300/V378A						
I44-l	45°	350	4.00			
144-2	45°	350	2.89			
I44-3	45°	350	4.49			
Avg.			3.79			
144-1	45°	450	3.86			
144-2	45°	450	2.63			
I44-3	45°	450	4.65			
Avg.	,		3.71			
143-4	90°	-67	29.5			
143-5	90°	-67	29.9			
143-6	90°	-67	25.9			
Avg.			28.4			
I43-4	90°	72	32.0			
143-5	90°	72	33.0			
143-6	90°	72	28.5			
Avg.			31.2			
	.,					
143-4	90°	350	42.6			
143-5	90°	350	40.4			
I43-6	90°	350	40.6			
Avg.			41.1			
I43-4	90°	450	43.6	44/47		
143-5	90°	450	42.1			
143-6	900	450	42.3			
Avg.			42.7			
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Test: Coefficient of Thermal Expansion Materials: HyE 1076J						
Specimen Number	Fiber	Temp. Range (°F)	Coeff. Therm. Expansion (10 ⁻⁶ in/in-°F)	Remarks		
1	0.0	-67	0.152			
2	0.0	-67	0.120			
3	0.0	-67	0.130			
Avg.			0.151			
1	.00	72	-0.560			
2	0.	72	-0.578			
3	0°	72	~0.475			
Avg.			~0.538			
1	0°	260	-0.365			
2	0°	260	-0.486			
3	0°	260	-0.457			
Avg.			-0.436			
1	0°	350	-0.288			
2	0.0	350	-0.492			
3	0°	350	-0.180			
Avg.			-0.320			
1	90°	-67	21.9			
2	90°	-67	22.4			
3	90°	-67	22.2			
Avg.			22.2	·		
4	90°	72	23.8			
5	90°	72	25.2			
6	90°	72	24.3			
Avg.			24.4			

Marine Commence

Material				
Specimen Number	Fiber Orien- tation	Temp. Range (°F)	Coeff. Therm. Expansion (10 ⁻⁶ in/in-°F)	Remarks
K20-A	0°	-67	0.17	
к20-в	0 °	-67	-0.06	
K20-C	0°	-67	0.15	
Avg.			0.08	
K20-A	0.	72	-0.34	
K20-B	0°	72	-0.41	
K20-C	0°	72	-0.38	
Avg.			-0.37	
K20-A	0.0	260	-0.27	
К20-В	0°	260	-0.39	
K20-C	0°	260	-0.48	
Avg.			-0.38	
K20-A	0°	350	-0.15	
K20-B	0°	350	-0.17	
K20-C	0°	350	-0.29	
Avg.			-0.20	
K20-D	90°	-67	23.0	
K20-E	90°	-67	22.0	
K20-F	90°	-67	22.5	
Avq.			22.5	
K20-D	90°	72	24.5	
K20-E	90°	72	24.0	
K20-F	90°	72	25.3	
Avg.			24.8	
		 		

rest: C Material	5: G-160/	6535-1	nermal Expansion	
pecimen Number	Piber	Temp. Range (°F)	Coeff. Therm. Expansion (10-6in/in-°F)	Remarks
K20-D	90°	260	29.8	
K20-E	90°	260	30.2	
K20-F	90°	260	29.9	
Avg.			30.0	
K20-D	90°	350	33.2	
K20-E	90°	350	31.7	
K20-F	90°	350	32.3	
Avg.			32.4	
K40-A	±45	-67	3.05	
K40-B	±45	-67	2.60	
K40-C	±45	-67	3.13 /	
Avg.		· · ·	2.93	
K40-A	±45	72	2.25	
K40-B	±45	72	2.51	
K40-C	±45	72	2.61	
Avg.			2.46	
K40-A	±45	260	2.24	
K40-P	±45	250	2.23	
K40-C	±45	260	2.24	
Avg.			2.24	
K40-A	±45	350	2.88	
к40-в	±45	350	2.55	
K40~C	±45	350	2.19	
Avg.			2.54	
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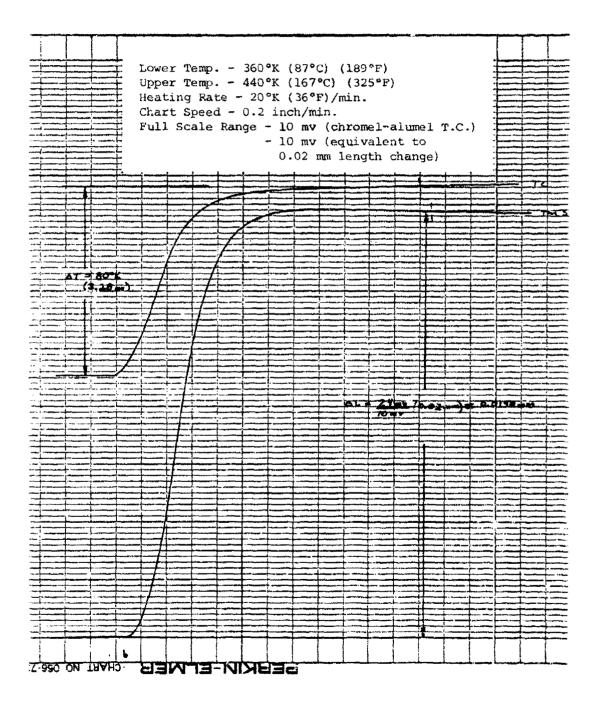


Figure K-1. Thermal Expansion Characteristics of SiC/5506 Composite Laminate; 90° Fiber Direction.

APPENDIX L SPECIFIC HEAT DATA

All of the specific heat data generated during this program are presented in this section. A typical set of differential scanning calorimeter (DSC) traces, from which specific heat is determined, is included at the end of this section.

The values listed in the succeeding tables were computed according to the following equation:

$$C_p(\text{sample}) = \frac{\text{mass of sapphire stnd.}}{\text{mass of sample}} \times \frac{D_3^{-D_1}}{D_2^{-D_1}} \times C_p(\text{sapphire stnd.}),$$

where, D_1 , D_2 and D_3 represent the relative displacements of the DSC curves for the empty aluminum pan, sapphire reference, and sample, respectively. For the sample traces included,

$$C_p(HyE\ 1076J, \#1) = \frac{8.54gm}{4.23gm} \times \frac{12.4 \text{ div} - 17.2 \text{ div}}{10.8 \text{ div} - 17.2 \text{ div}} \times 0.22545 \frac{\text{cal}}{\text{gm}^{-6}K}$$

= 0.341 cal/gm-°K, or 0.341 BTU/1b-°F at 400°K, or 260°F.

Test: Speci	ific Heat			
Materials:	See Rema	rks Column		
Specimen Number	Avg. Temp. (°F)	Specific Heat (Btu/lb-°F)	Remarks	
	-67	0.081	T300/AFR800 These are average value	
	72	0.203	T300/AFR800 Individual values were	
	260	0.302	T300/AFR800 detroyed in flood.	
	350	0.308	T300/AFR800	
	-67	0.186	SiC/5506 These are average value	
	72	0.221	SiC/5506 Individual values were	
ga+ and ugg	260	0.279	SiC/5506 destroyed in flood.	
	350	0.309	SiC/5506	
11	-67	0.110	HyE 2034D	
11	72	0.202	HyE 2034D	
11	260	0.642	HyE 2034D	
11	350	0.718	HyE 2034D	
1	-67	0.123	T300/V378A	
l	72	0.206	T300/V378A	
1	260	0.748	T300/V378A	
1	350	0.761	T300/V378A	
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Test: Specif	ic Heat		
Materials:	нув 1076)		
Specimen Number	Avg. Temp. (°F)	Specific Heat (Btu/lb-°F)	Remarks
1	-67	0.213	
2	-67	0.124	
3	-67	0.123	
Avg.		0.153	
1	72	0.267	
2	72	0.177	
3	72	0.172	
Avg.		0.205	
1	260	0.341	
2	260	0.253	
3	260	0.228	
Avg.	<u> </u>	0.274	
1	350	0.411	
2	350	0.302	
3	350	0.278	
Avg.		0.330	
	+		

Test: Speci	fic Heat		
Materials:	G-160/653	35-1	
Specimen Number	Avg. Temp. (°F)	Specific Heat (Btu/1b-°F)	Remarks
1	-67	0.115	
2	-67	0.180	
3	-67	0.167	
Avg.		0.154	
1	72	0.164	
2	72	0.240	
3	72	0.201	
Avg.		0.202	
1	260	0.230	
2	260	0.322	
3	260	0.292	
Avg.		0.281	
1	350	0.264	
2	350	0.381	
3	350	0.355	
Avg.		0.333	

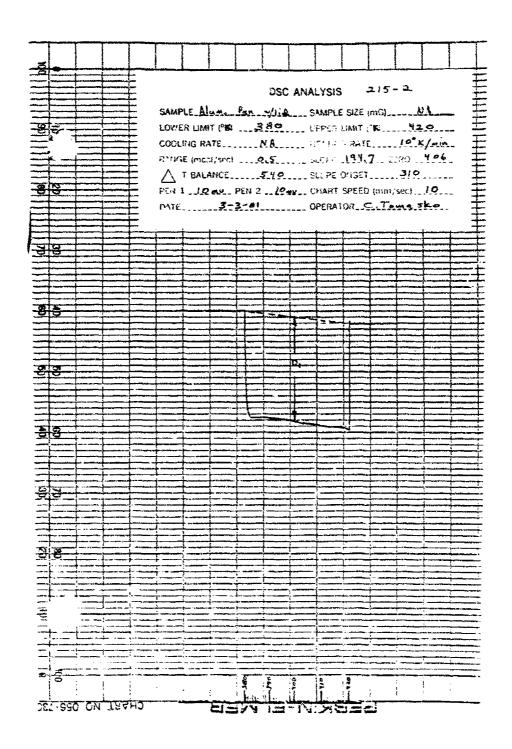


Figure L-1. DSC Analysis of Empty Sample Pan.

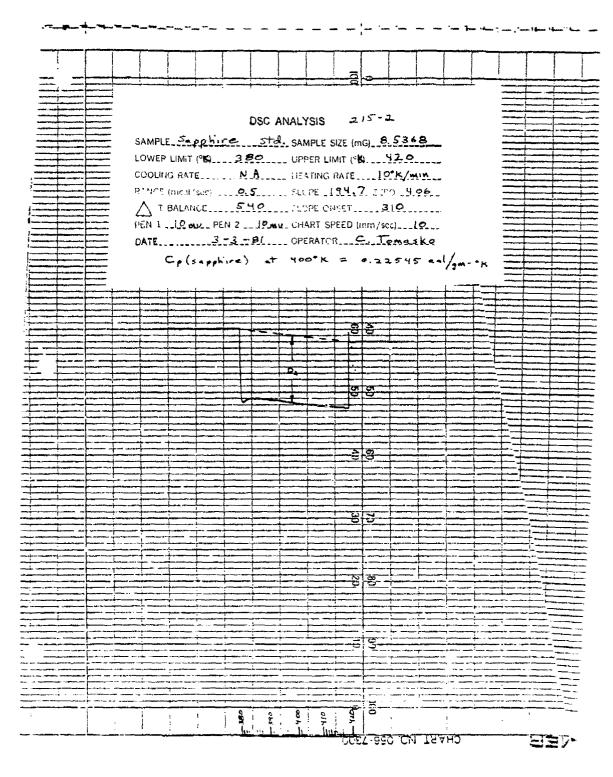


Figure L-2. DSC Analysis of Sapphire Reference Standard.

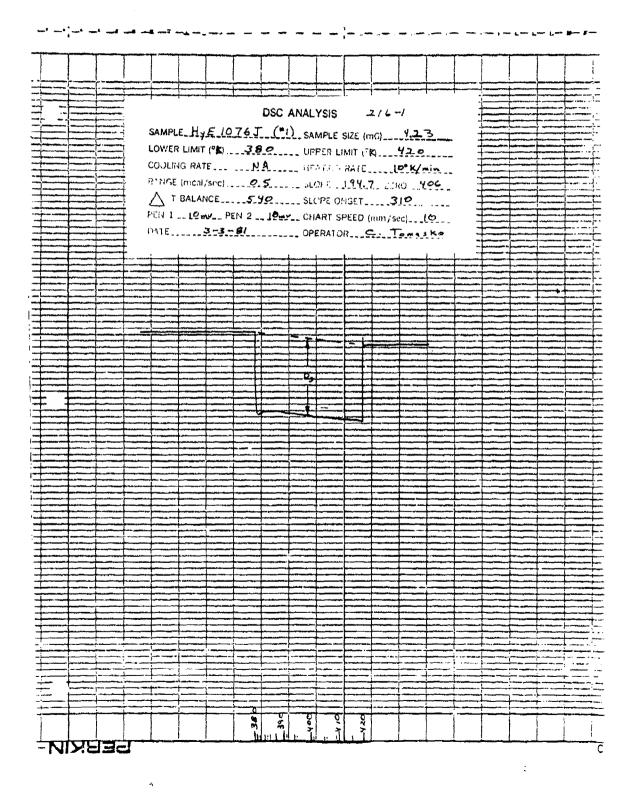


Figure L-3. DSC Analysis of HyE 1076J Graphite/Epoxy Composite Material.

# APPENDIX M THERMAL CONDUCTIVITY DATA

All of the thermal conductivity measurements made during this program are tabulated in this section. The average values presented in Sections 4.1 through 4.6 were taken from linear regression curves drawn through all of the respective data points tabulated here.

Test: Thermal Conductivity					
Material	s: T300/	AFR800			
Specimen Number	Piber Orien- tation	Temp.	Thermal Conductivity (Btu-ft/ft ² -hr-"F)	Remarks	
F37-1	0°	-69	0.295		
F37-1	0°	-30	0.341		
F37-1	0°	56	0.364		
F37-1	0°	60	0.486		
F37-1	0°	65	0.854		
F37-1	0°	67	0.244		
F37-1	0°	70	0.611		
F37-1	0°	74	0.308		
F37-1	0 °	77	0.399		
F37-1	0°	81	0.499		
F37-1	0°	82	0.301		
F37-1	0 °	85	0.568		
F37-1	0°	91	0.552		
F37-1	0°	93	0.295		
F37-1	0°	96	0.434		
F37-1	0°	100	0.331		
F37-1	0°	101	0.491		
F37-1	0°	106	0.508		
F37-1	0°	112	0.487		
F37-1	0°	117	0.494		
F37-1	0°	118	0.529		
F37-1	0°	125	0.459		
F37-1	0°	130	0.524		
F37-1	0°	136	0.508		
F37-1	0°	136	0.385		
F37-1	0°	145	0.529		
F37-1	0°	150	0.481		
F37-1	0°	160	0.544		
F37-1	0°	164	0.557		
F37-1	0°	222	0.410		

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Specimen Number	Fiber Orien- tation	Temp.	Thermal Conductivity (Btu-ft/ft ² -hr-°F)	Remarks
F37-1	0°	235	0.558	
F37-1	0 °	291	0.463	
F37-1	0°	325	0.467	
F37-1	0 °	350	0.510	
F37-2	00	-83	0.379	~~
F37-2	0°	-59	0.375	
F37-2	0.0	89	0.564	
F37-2	0°	117	0.486	
F37-2	0°	144	0.536	
F37-2	0°	170	0.502	
F37-2	0°	217	0.551	
F37-2	0°	279	0.515	
F37-2	ŋ°	354	0.643	
F3 <b>7</b> -3	0.0	<b>-7</b> 5	0.294	
F37-3	0°	-50	0.299	
F37-3	0 °	-22	0.306	
F37-3	0°	91	0.494	
F37-3	0°	119	0.393	
F37-3	0.	146	0.424	
F37-3	0.0	173	0.431	
F37-3	0.0	222	0.443	برورون المالية والمالية والم
F37-3	0°	273	0.479	
F37-3	ij٥	334	0.503	
F37-3	0°	351	0.500	

Test: Thermal Conductivity Materials: T300/AFR800					
Material Specimen Number	Fiber Orien- tation	Temp.	Thermal Conductivity (Btu-ft/ft ² -hr-°F)	Remarks	
F38-1	±45°	-61	0.343		
F38-1	±45°	-50	0.373		
F38-1	±45°	61	0.288		
F38-1	±45°	100	0.360		
F38-1	±45°	139	0.311		
F38-1	±45°	217	0.418		
F38-1	±45°	300	0.429		
F38-1	±45°	343	0.430		
,					
F38-2	±45°	-82	0.280		
F38-2	±45°	-49	0.297		
F38-2	±45°	90	0.374		
F38-2	±45°	116	0.370		
F38-2	±45°	142	0.370		
F38-2	±45°	173	0.364		
F38-2	±45°	221	0.396		
F38-2	±45°	269	0.414		
F38-2	±45°	323	0.447		
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	chermal Co ls: SiC/55	onductivity		
Specimen Number	Fiber Orien- tation	Temp.	Thermal Conductivity (Btu-ft/ft ² -hr-°F)	Remarks
G10-1	0 °	-102	0.456	
G10-1	0°	- 48	0.567	
G10-1	0°	88	0.512	
G10-1	0.0	106	0.650	
G10-1	0°	128	0.583	
G10-1	0°	156	0.623	
G10-1	0°	182	0.602	
G10-1	00	238	0.581	
G10-1	0°	290	0.626	
G10-1	00	339	0.608	**************************************
G10-1	0°	351	0.672	
G10-1	0°	395	0.547	
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G10-2	0.0	- 45	0.573	
G10-2	0.0	- 16	0.521	
G10-2	0 °	88	0.579	
G10-2	0.0	113	0.576	
G10-2	0°	143	0.665	
G10-2	0°	169	0.613	
G10-2	0 °	198	0.630	
G10-2	0°	241	0.636	
G10-2	0°	293	0.645	
G10-2	0 °	338	0.662	
G10-2	0°	376	0.630	

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Test: S	Chermal Co Ls: HyE 2	034D	<u> </u>	
Specimen Number	Fiber Orien- tation	Temp.	Thermal Conductivity (Btu-ft/ft ² -hr-°F)	Remarks
132-3	0°	-57	0.643	
<b>≀32−3</b>	0.0	-35	0.633	
132-3	0°	8	0.701	
132-3	0.0	81	0.771	
132-3	0.0	111	0.949	
132-3	0°	136	0.758	
132-3	0°	174	0.720	
132-3	0.0	217	0.735	
132-3	0°	264	0.788	
132-3	0.	312	0.841	
132-3	00	353	0.863	
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Test: T	hermal Co	nductivit	V	
Material				
Specimen Number	Fiber Orien- tation	Temp.	Thermal Conductivity (Btu-ft/ft ² -hr-°F)	Remarks
H37-1	±45°	99	0.516	
н37-1	±45°	113	0.625	
н37-1	±45°	111	0.507	
H371	±45°	146	0.551	
н37-1	±45°	140	0.523	
H37-1	±45°	170	0.607	
н37-1	±45°	170	0.629	
H37-1	±45°	199	0.563	
н37-1	±45°	235	0.594	
H37-1	±45°	231 .	0.585	
н37-1	±45°	286	0.596	
H37-1	±45°	331	0.584	
H37-1	±45°	339	0.603	
н37-2	±45°	96	0.460	
H3 <b>7-</b> 2	±45°	110	0.601	
н37-2	±45°	138	0.572	
н37-2	±45°	164	0.533	
н37-2	±45°	192	0.576	
H37-2	±45°	228	0.555	
H37-2	±45°	274	0.603	
H37-2	±45°	305	0.638	
н37-2	±45°	366	0.555	
н37-3	±45°	80	0.703	
H37-3	±45°	88	1.417	
н37-3	±45°	91	0.985	
н37-3	±45°	101	1.464	
н37-3	±45°	111	1.44	
н37-3	±45°	125	1.238	
н37-3	±45°	196	0.764	
H37-3	±45°	244	0.613	

Test: 1	hermal Co	nductivity		
Material Specimen Number	Fiber Orien- tation	Temp.	Thermal Conductivity (Btu-ft/ft ² -hr-°F)	Remarks
н37-3	±45°	286	0.377	
H37-3	±45°	326	0.330	
н37-3	±45°	370	0.375	
н37-3	±45°	55	0.257	
н37-3	±45°	40	0.390	
н37-3	±45°	-130	1.093	
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Specimen Number	Fiber Orien- tation	Temp.	Thermal Conductivity (Btu-ft/ft ² -hr-°F)	Remarks
143-1	.0 0	62	0.331	
I43-1	.0 °	92	0.363	
143-1	.0 °	121	0.372	
143-1	0°	154	0.384	
143-1	.00	188	0.397	
143-1	0°	230	0.410	
I43-1	0°	272	0.440	
I43-1	0°	310	0.452	
143-1	0°	337	0.457	
143~2	0°	61	0.305	
143-2	0°	92	0.335	
143-2	0°	123	0.346	
143-2	0°	157	0.331	
143-2	0°	235	0.396	
143-2	0°	235	0.398	
143-2	0°	276	0.399	
143-2	0°	316	0.408	
143-2	0°	339	0.419	
143-3	0.	-51	0.282	
143-3	0°	-20	0.116	
143-3	0°	-18	0.244	
I43-3	0°	61	0.370	
143-3	0°	92	0.365	
143-3	0°	120	0.395	
143-3	0°	154	0.399	
143-3	0°	191	0.356	
143~3	0°	230	0.424	
143-3	0°	273	0.467	
I43-3	0°	312	0.436	
143-3	0°	339	0.462	

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	Chermal Co Ls: T300/V	onductivit	Y	
Specimen Number	Fiber Orien- tation	Temp.	Thermal Conductivity (Btu-ft/ft ² -hr-°F)	Remarks
144-1	±45°	-64	0.249	
144-1	±45°	-39	0.242	
144-1	±45°	-19	0.249	
I44-l	±45°	72	0.225	
144-1	±45°	97	0.327	
144-1	±45°	124	0.328	
144-1	±45°	121	0.318	
I44-l	±45°	123	0.320	
144-1	±45°	149	0.329	
I44-1	±45°	195	0.335	
144-1	±45°	207	0.352	
144-1	±45°	255	0.354	
144-1	±45°	280	0.363	
144-1	±45°	369	0.394	
I44-l	±45°	367	0.287	
144-1	±45°	412	0.405	
144-1	±45°	436	0.414	
144-2	±45°	0.7	0.272	
144-2	+45°	-82 -44	0.273	<del></del>
144-2	±45°	18	0.351	
144-2	±45°	119	0.388	
144-2	±45°	175	0.347	
144-2	±45°	255	0.376	
144-2	±45°	368	0.432	
144-2	±45°	368	0.426	
144-2	±45°	435	0.462	
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Test: ' Materia	Thermal Co ls: T300/V			
Specimen Number	Fiber Orien- tation	Temp.	Thermal Conductivity (Btu-ft/ft ² -hr-°F)	Remarks
144-3	±45°	-66	0.264	
<b>144-</b> 3	±45°	-63	0.271	
144-3	±45°	-55	0.269	
144-3	±45°	93	0.290	
144-3	±45°	121	0.288	
144-3	±45°	177	0.287	
144-3	±45°	260	0.343	
<b>I44-</b> 3	±45°	374	0.367	
144-3	±45°	418	0.376	
144-3	±45°	447	0.383	
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Specimen Number	Fiber Orien- tation	Temp.	Thermal Conductivity (Btu-ft/ft ² -hr-°F)	Remarks
J33-1	±45°	92	0.445	
733-1	±45°	124	0.567	
J33-1	±45°	145	0.545	
733-1	±45°	214	0.578	
J33-1	±45°	258	0.570	
733-1	±45°	311	0.578	
733-1	±45°	341	0.601	
33-2	±45°	91	0.297	
J33-2	±45°	116	0.429	<del></del>
J33-2	±45°	138	0.400	***************************************
J33-2	±45°	203	.0.417	
33-2	±45°	248	0.471	
J33-2	±45°	305	0.513	
J33-2	±45°	334	0.453	
J33-3	±45°	93	0.497	
J33-3	±45°	120	0.493	
J33-3	±45°	145	0.460	
J33-3	±45°	208	0.604	
J33-3	±45°	260	0.563	
<b>J33-</b> 3	±45°	305	0.572	
J33-3	±45°	343	0.580	<del>,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,</del>
J:3-3	±45°	-72	0.226	
J33-3	±45°	-60	0.222	
J33-3	±45°	-51	0.272	
T33-3	±45°	-25	0.273	

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Specimen Number	Fiber Orien- tation	Temp.	Thermal Conductivity (Btu-ft/ft ² -hr-°F)	Remarks
J34-l	0.0	-75	0.418	
J34-1	0.0	-47	0.397	
J34-1	0°	-26	0.397	
J34-1	0°	91	0.380	
J34-l	0°	111	0.416	
J3 <b>4-</b> l	0.0	141	0.402	
J34-1	0°	211	0.432	
J34-l	0°	278	0.494	
J34-1	0°	324	0.480	
J34-1	0.0	<b>33</b> 5	0.519	
134-2	0.0	95	0.393	
J34-2	0°	109	0.443	
J34-2	0°	139	0.451	
J34-2	0°	187	0.453	
J34-2	0°	234	0.460	
34-2	0°	263	0.460	
J34-2	0°	308	0.509	
J34-2 o	0°	333	0.531	
J34-2	0°	343	0.535	
734-3	0°	91	0,425	
J3 <b>4-</b> 3	0.0	128	0.437	
734-3	0 °	138	0.447	
J34-3	C.	205	0.483	\\\\\\\\
<b>734-</b> 3	0°	269	0.488	·······
J34-3	0°	312	0.518	
J34-3	0°	327	0.521	

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Materia.	ls: G-160/	6535-1		
Specimen Number	Fiber Orien- tation	Temp.	Thermal Conductivity (Btu-ft/ft ² -hr-°F)	Remarks
K20-1	0°	81	0.397	
K20-1	0°	107	0.421	
K20-1	0°	132	0.458	
K20-1	0°	160	0.466	
K20-1	0°	217	0.509	
K20-1	0.0	265	0.517	
K20-1	0°	311	0.509	
K20-1	0°	352	0.531	
K20-2	0°	80	0.437	
K20-2	0°	106	0.450	
K20-2	0°	133	0.456	
K20-2	0°	163	0.496	<u> </u>
K20-2	0°	712	0.511	
K20-2	0°	255	0.580	
K20-2	0°	303	0.743	
K20-2	0°	342	0.619	
K20-3	0.0	-25	0.113	
K20-3	0°	-25	0.253	,
K20-3	10	-19	0.208	<u> </u>
K20-3	0°	-3	0.258	······································
K20-3	0 °	85	0.357	سيتسببها الدائلات مراجع بسيميها الناسب
K20-3	0°	111	0.388	
.<20⋯3	0°	133	0.453	
K20-3	0 ^	164	0.479	
K20-3	00	217	0.641	<del></del>
K20-3	0°	267	0.597	
K20-3	0°	312	0.658	
K20-3	0°	347	0.665	

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Specimen Number	Fiber Orien- tation	Temp.	Thermal Conductivity (Btu-ft/ft ² -hr-°F)	Remarks
K40-1	±45°	-62	0.395	
K40-1	±45°	-47	0.390	
K40-1	±45°	-21	0.426	
K40-1	±45°	107	0.435	
K40-1	±45°	131	0.457	
K40-1	±45°	161	0.509	
K40-1	±45°	256	0.496	
K40-1	±45°	300	0.659	10 mm - 1 mm - 1 mm - 1 mm - 1 mm - 1 mm - 1 mm - 1 mm - 1 mm - 1 mm - 1 mm - 1 mm - 1 mm - 1 mm - 1 mm - 1 mm
K40-1	±45°	345	0.594	
K40-2	±45°	80	0.395	
K40-2	±45°	105	0.449	
K40-2	±45°	133	0.437	نامه استان بر در در <u>در در بازی این ۱</u> استان افاد بر داد بروی
K40-2	±45°	162	0.459	
K40-2	±45°	208	0.468	
K40-2	±45°	252	0.497	· ····································
K40-2	±45°	297	0.546	
K40-2	±45°	344	0.516	
K40-3	±45°	81	0.417	
K40-3	±45°	109	0.438	
K40-3	±45°	131	0.447	
K40-3	±45°	174	0.473	
K40-3	±45°	219	0.448	
K40-3	±45°	265	0.454	
K40-3	±45°	311	0.513	
K40-3	±45°	350	0.521	

## APPENDIX N GLASS-TRANSITION TEMPERATURE DATA

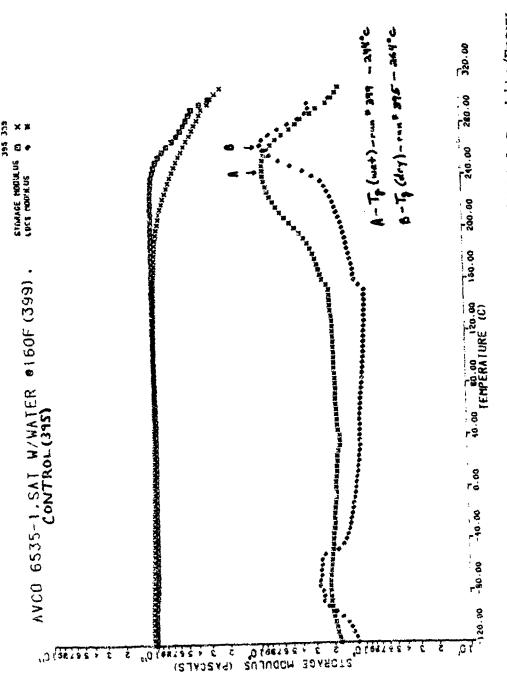
The glass-transition temperatures determined for the materials characterized during this program are presented here along with a typical loss-modulus vs. temperature trace, from which the  $T_g$ 's are determined by DMA.

#### GLASS TRANSITION TEMPERATURE

Material	Dry Tg (°f)	Wet ¹ Tg (°F)
T300/AFR800	468	381
sic/5506	394	293
HyE 2034D	430	342
T300/V378A ²	702	702
НуЕ 1076Ј	518	493
G-160/6535-1	507	471

¹Specimen exposed to 160°F (71°C) and 100% R.H. until it reached equilibrium weight gain.

²This material gained weight very rapidly during humidity aging. If it dried just as rapidly also, the specimen may have been completely dry by the end of the test, hence, the wet value indicated may actually have been for a dry material.



Dynamic Mechanical Analysis of G-160/6535-1 Graphite/Epoxy Composite Material. Figure N-1.

## APPENDIX O HUMIDITY AGED TENSION DATA

All of the tensile data generated during this program on specimens which had been humidity aged at 160°F (71°C) and 100% R.H. are presented in this section. Summaries of these data are tabulated and plotted in the form of stress-strain curves in Sections 4.1 through 4.6.

Avq.

100% saturation

0.04

1.30

1590

*

1.19 1.26 0.24

400

1

0.08

Std.Dev

100% saturation 100% saturation

1.26

1,848 1,848

1,848

2190 1.290 1450

1 1

1.42 0.95 1.47

> 01:10 1.07 1.01 1.02

0.91

1.78 1,28 1.47 1.42 0.21

260 360 260 260

06

F14-10

8

F16-3

F17-3

06 **.**06

F18-8

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Test:	Tensio	Tension After	Enviro	nmental	Aging @ 16	160°F &	100% R.H		Material: sic	sic/5506
	1	Test	Ult.	Init.	Stress at		UIE.	Exposure	Weight	AND THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPER
Spec.	riber Orien.	remp. (°F)	Strgta. (ksi)	(10°psi)	Krop. Lim. (ksi)	Fols. Ratio	Strain (Lin/in)	Time (hrs)	(&)	Remarks
G9-2	•06	72	9.04	2.97	2.69	1	3600	175	0.60	50% saturation
G9-11	<b>0</b> 06	72	8.20	3.06	2.25		3300	175	0.62	50% saturation
G22-8	900	72	9.50	2.83	2.42		3870	175	0.59	50% saturation
G25-8	<b>0</b> 06	72	8.66	3.44	1.65		3190	175	0.59	50% saturation
G26-8	90.	72	8,43	3.08	2.29		3200	175	0.56	50% saturation
Avg.			8.77	3.03	2.26	-	3420		0.59	
Std. Dev			0.51	0.23	0.38		310		6.02	
C9-10	900	260	4.27	0.92	1.14		008	175	0.61	50% saturation
G22-4	90°	260	3.98	1.09	0.82	1 2	0058	175	0.62	50% saturation
624-6	90°	260	3.78	1.15	99.0		7700	175	0.62	
G25-2	• 05	260	3.77	1.34	0.83	1 .	6700	175	0.58	50% saturation
G26-6	906	260	3.29	1.03	0.56	*****	7000	175	0.58	50% saturation
Avg.			3.82	1.11	0.81	10 .00 100	7640		09.0	
Std.Dev			0.36	0.16	0.22	1 4 1	790		0.02	e plane in anno enquestipe adjunction in a secun singuistic and in the ages, parent
698	906	72	5.02	2.37	3.10		2380	1,546	1.28	100% saturation
G24-5	906	72	6.52	2.49	3.10	1	3000	1,546	1.29	100% saturation
G25-7	ಿ.೧	7.5	6.81	2.64	2.29	-	2900	1,546	1.23	100% saturation
G26-3	90	72	6.39	2.52	3.12		2910	1,546	1.24	100% saturation
G26-9	90 =	72	6.14	2.87	1.30	40 TH 197	2630	1,546	1.27	100% saturation
Avg.			6.17	2.58	2,58	man gán dar	2760		1.26	
Std.Dev			0.69	0.19	08.0		260		0.03	en en en en en en en en en en en en en e
G9-1	906	260	2.02	1.08	0.81	47 ma 74	3680	1,546	1.27	
622-6	* 06	760	1.75	0.51	0.64		4880	1,546	1.21	100% saturation
G22-7	90.	260	1.89	0.70	0.66		4310	1,546	1.23	100% saturation
G24-8	90°	260	1.82	0.47	0.55	1	6100	1,546	1.29	100% saturation
G25-1	°06	260	2.19	1.01	0.72		6070	1,546	1.32	100% saturation
Avg.	i		1.93	0.75	0.68	1 4 4	5010		1.26	
Std.Dev			0.17	0.28	0.10	1 1 1	1070		0.04	

Test:	Tension	on After	Enviro	nmental	Aging @ 16	160°F &	100% R.H.		Material: HyB	E 2034D
Spec.		Test Temp.	Ult. Strgth.	Init. Mgd.	Stress at Prop.Lim.	Pols.	Ult. Strain	Exposure Time	Weight	And the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of t
No.	Orien.	(3E)	(ksi)	(10°psi)	(ksi)	Ratio	(hin/in)	(hrs)	(8)	Remarks
H36-8	"06	72	2.67	96.0	0.76	, 1	2830	216.75	0.79	50% saturation
Н367	906	72	2.13	0.90	0.75	100	2400	216.75	0.79	50% saturation
H36-1	<b>.</b> 06	7.2	2.21	96.0	1.15	1	2400	216.75	0.80	50% saturation
H36-4	60ء	72	2.85	0.97	1.08	-	3000	216.75	0.79	50% saturation
H36-2	900	72	2.79	0.96	1.14	000 day sad	2960	216.75	0.78	50% saturation
Avg.			2.53	0.95	0.98		2720		0.79	
Std.Dev			0.34	0.03	0.20	***	300		0.01	
H35-2	90.	260	1.89	0,74	0.82	10 00 01	2830	216.75	0.77	50% saturation
H35-4	906	260	1.81	0.67	1.04	4 30 1	2920	216.75	0.79	
H35-5	900	260	1.44	0.76	0,62		2180	216.75	0.78	50% saturation
H35-6	900	260	1.69	0,69	08.0		26.70	216.75	0,80	50% saturation
H36-10	90°	26c	1.76	0.71	0.72		2690	216.75	0.80	50% saturation
Avg.			1.72	0.71	08.0		2660		0.79	
Std.Dev.			0.17	0.04	0.16		280		0.01	
H3-8	606ء	72	1.65	1.00	1,22		1,700	982	1.17	100% saturation
H4-1	906	72	2.25	1.07	1.14		2200	982	1.14	100% saturation
H4-6	30°	72	2.38	1.03	1.71		2300	982	1.22	100% saturation
H4-7	°06	72	1.87	0,99	1.60		2000	982	1.17	100% saturation
H6-5	900	72	2.09	0.93	1.77		2300	982	1.19	100% saturation
Avg.			2.05	1.00	1.49	-	2100	982	1.18	
Std.Dev			0.29	0,05	0.29		260		0.03	e de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de la companya de l
H3-4	906	260	0.88	0.43	0,88	an -a es	2100	982	1.17	100% saturation
H3-5	906	260	0.94	0.47	0.94	1	2100	982	1.16	100% saturation
H6-4	900	260	1.21	0.48	1.01	-	2700	982	1.17	100% saturation
H6-8	906	260	1.04	0.63	0.82		2000	982	1.17	100% saturation
H7-4	90°	260	1.13	0.59	08.0		2100	982	1.28	100% saturation
Avq.			1.04	0.52	0.89	I 1	2200		1.19	
Std.Dev.			0.13	0.09	0.09	-	280		0.05	

					<b>i</b>				C+ OTSTANS	#9/ 0A/000#
		Test	UIF	Init.	Stress at		UIE.	Exposure	Welght	A PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF
Spec. No.	riber Orien.	Temp.	Strgth.	Mod.	Prop.Lim.	Pois.	Strain	Time	Gain	•
115-2	900	7.2	_		, , , ,	2	free freeze	/8 TIT	(2)	Kemarks
	200	7,	3.40	1.31	4.08		4100	18	0.75	50% saturation
1-917	206	12	6.11	1.39	2.22	- L	4600	18	0.74	50% saturation
1129-3	205	7.2	9.90	1.32	4.25		6200	81	0.79	ŧ
7.70-6	206	72	4.97	1.28	4.97	1 1 7	3800	1.8	0.81	
C-771	206	72	4.66	1.27	4.66	1 1	3600	18	0.80	,
AVG.			5.56	1.31	4.03	1 1 7	4460		0.78	į
Std.Dev			0.80	0.05	1.67		1040		0.03	And the second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second s
112-1	906	350	3.92	1,16	0.85		3800	18	0.72	50% saturation
2-277	3	350	4.48	1.17	0.63		4700	18	0.79	ł
2-611	06	350	4.81	0.96	1.67		3900	18	0.83	•
1.20-3	200	350	3.54	1.08	0.79	-	3700	18	0.78	
9-777	906	350	2.62	1.07	0.75	1	2700	18	0.81	50% Saturation
Avg.			3.87	1.09	0.94		3760		0.79	1
Sta.Dev.			0.86	0.08	0.42	11.00	710		0.04	A PROPERTY AND THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF
. 21	1000									
5-277	20.	16	3.96	1.34	3,54		3000	2588	1.76	100% saturation
9-977	06	722	3.58	1.30	3.55		2700	2588	1.75	
113-/	206	72	3.81	1.28	3.43	1	2930	2588	1.77	
118-4	006	7.7	4.22	1.32	3.45		3250	2583	1.76	100% gaturation
6-877	900	723	3.96	1.30	3.94	-	2970	2588	1.77	100% saturation
AVG.			3.90	1.31	3.58		2970		1.76	1
Std.Dev.		1	0.24	0.02	0.21	1	200		0.01	
7 0	800									
2.011	202	000	0.84	0.94	0.66	1	900	2588	1.77	100% saturation
120-10	906	350	0.59	0.78	0.29		700	2588	1.75	100% saturation
121-2	000	25.0	96.0	07.7	0.59	-	800	2588	1.64	100% saturation
7 7 7	-06	000	0.80	1.15	0.36		1000	2588	1.73	100% saturation
5-777	206	350	0.78	0.71	0.70		800	2588	1.74	
Avg.			0.73	0.94	0.52	10 To 10	840		1.73	
ra.nev.	_									

Test:	Tension	n After	Enviro	nmental	Aging @ 16	160°F &	100% R.H.		Material: HyE	10763
		Test	UIt.		Stress at		Ult.	Exposure	Weight	
Spec.	Fiber	Temp.	Strgth.	Mod.	Prop.Lim. (ksi)	Pois. Ratio	Strain (pin/in)	trille (hrs)	(8)	Remarks
NO.	Or relie		7 200	1 15	2.43		4300	162	08.0	50% saturation
327-6	°06	7.7	5.38	5.4	V 0 V		3600	162	0.78	50% saturation
328-10	90°	72	4.94	1.3/	200		3000	162	0.77	50% saturation
329-6	906	72	4.30	7.46	200.2	4-14-14	3600	162	0.71	50% saturation
330-4	906	72	4.64	1.23			0006	162	0.81	50% saturation
J30-9	906	7.2	4.14	1.52	57.7		0000	Waynes and the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the same of the sam	0.77	
Avg.			4.80	1.41	3.49		540		0.04	
Std.Dev			0.73	60.0	COT					
					90 6		3200	162	0.75	50% saturation
126-9	906	260	3.63	1.24	2,00		2400	162	0.76	50% saturation
727-4	90.	260	2.47	1.22	0.72		3000	162	0.80	50% gaturation
127-7	906	260	3.13	1.17	68.0		2500	162	0.75	50% saturation
J28-6	906	260	2.58	/O.T	55.7		2401)	162	0.73	50% saturation
,129-9	906	260	2.74	1.31	0.93		2700		0.76	
Avg.			2.91	1.20	76.7		370		0.03	
Std.Dev			0.47	60.0	0.04					
						-	0000	1.774	1.18	100% saturation
J26-4	900	7.2	4.26	1.49	4.26		0000	1.774	1.14	100% saturation
J26-10	90°	7.2	4.15	1.52	4-15		2200	1 77.6	1.17	100% saturation
327-5	.06	7.2	3.80	1.42	•1		2000	7 2 2 7	1.17	100% saturation
.128-2	•06	7.2	3.98	1.30	3.98		2800	11/12	1.17	
328-8	°06	7.2	3.94	1.33	3.94		2900		1.17	1
Avg.			4.03	1.41	-1		001		0.02	
Std.Dev			0.18	07.0	0.58					
				1		-	000	177	1.16	100% saturation
126-7	900	262	1.87	1.20	1.06	1	000	1 774	1.17	100% saturation
J29-7	906	260	1.99	1.11	1.37		1100	7774	1.15	100% saturation
J30-1	906	260	1,21	1.13	0.69		2002	7.7.7	1.17	1
J30-5	906	260	1.26	0.88	1.07		1300	77.7	1.18	ŧ
330−8	90°	260	1.09	0.83	1.09	2 1	7.700		1.17	
AVG.			1.49	1.03	1.05	1	1400	***************************************	0.03	
Std.Dev	,		0.42	0.16	0.24		300	-		

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Test:	Tensio	Tension After	ı	Environmental	Aging @ 10	160°F &	100% R.H.		Material: G-1	G-160/6535-1
000	<b>L</b>	Test		Init.	Stress at		Ult.	Exposure	Weight	
No.	orien.	(°F)	rgen. ai)	(10 ⁶ psi)	rrop.nim. (ksi)	Ratio	Strain (uin/in)	Time (hrs)	(8)	Remarks
K14-6	906	72	3.32	1.64	3.32	l l	2050	216	69.0	50% saturation
K14-10	<b>0</b> 06	72	3.85	1.77	3.85	i i	2200	216	0.65	50% saturation
K15-8	906	72	4.11	1.79	4.11	1 1	2270	216	0.67	50% saturation
K16-9	°06	72	4.14	1.72	4.14	1	2410	216	0.68	50% saturation
K18-10	<b>,</b> 06	72	3.78	1.52	3.78	10. 20. 10	2480	216	0.66	50% saturation
Avg.			3.84	1.69	3.84	1 -1	2280		0.67	
Std.Dev			0.33	0.11	0.33	1 2 -	170		0.02	
K16-8	<b>0</b> 06	260	1.93	1.78	1.33	24 00 12	1150	216	0.67	50% saturation
K17-9	<b>0</b> 06	260	2.55	1.61	1.59	11 44 11	1700	216	0,70	50% saturation
K15-9	•06	260	2.58	1.52	1.78		1750	216	0.68	50% saturation
K45-9	<b>:</b> ,06	260	2.62	1.26	1.87	I	2150	216	99.0	50% saturation
K18-8		260	2.39	1.09	1.96	1	2230	216	0.69	
Avg.			2.41	1.45	1.71		1800		0.68	
Std.Dev			0.29	0.28	0.26	} }	430		20.0	And Marketine appears of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the sign of the s
K14-4	°06	72	2.56	1.66	2.56		1450	3388	1.29	100% saturation
K15-5	90,	72	1.95	1.78	1.95	26.00	1100	3388	1.29	
K16-6	°06	72	2.42	1.80	2.42		1400	3388	1.27	100% saturation
K1.7-6	906	72	2.25	1.61	2.25	a	1420	3388	1.30	100% saturation
K18-9		72	1.72	1.41	1.72	1 1	1230	3388	1.29	100% saturation
Avg.			2.18	1.65	2.18		1320		1.29	
Std.Dev			0.34	6.16	0.34		150		0.01	
K14-3	906	260	1.67	1.27	0.59	1 4	1730	3388	1,29	100% saturation
X15-7	90.6	260	1.61	1.34	0.58		1380	3388	1.28	100% saturation
K17-5	<b>,</b> 00	260	1.53	1.38	0.46	## <b>**</b> **	1450	3388	1.31	100% saturation
X.18-5	ە06 1	260	1.52	1.06	0.53		1630	3388	1.28	100% saturation
K45-5	06	260	1.61	1.17	0.75	- ( to etc.	1670	3388	1.27	100% saturation
Avg.			1.59	1.24	0.59		1570		1.29	
Std.Dev		-	0.06	0.13	0.11		150		0.01	

## APPENDIX P HUMIDITY AGED COMPRESSION DATA

All of the compression data generated during this program on specimens which had been humidity aged at 160°F (71°C) and 100% R.H. are presented in this section.

Summaries of these data are tabulated and plotted in the form of stress-strain curves in Sections 4.1 through 4.6.

Test: Co	Compression	)	After Env	nvironmental	tal Aging	@ 160°F	. s. 1008	R.H. M	Material:	T300/AFR800	$\neg$
		Test	Ult.		Stress at		UIt.	Exposure	Weight		
Spec. Fill	Fiber 7	Temp.	Strgth.	$\frac{\text{Mod}}{(10^6 \text{psi})}$	Prop.Lim. (ksi)	Fols. Ratio	Strain (µin/in)	(hrs)	(4)	Remarks	
	├	7.2	31,56	1.80	9.49	1 1	22,000	116	0.65	(3)	
<u> </u>	╀	72	7 -	1:	17.59	1	51,800	116	0.70	(1)	į
F35-29 90	$\vdash$	72		1.46	0		30,500	1.16	0.64	(1)	٦
<u> </u>	$\vdash$	72	36.62	٠.		-	53,000	116	0.64	(1)	٦
9	006	72	31.82	1.52		1 1	48,000	116	0.66	(1)	٦
↓_	-		32.92	•	14.29	\$ 14 ±	41,100		0.66		1
Std.Der			2.47	0.20	10,19	1 2 1	14,000		0.02	na periodi de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compansión de la compan	7
	_										1
F35-4 90	-	260	24.81	1.34	8.49	1 1	41,800	164	0.86	( ¥ )	1
	-	260	24.39	1.53	10.51		54,000	164	0.86	(1)	
L	-	260	26.13	1.50	10.58	1 1	34,500	164	0.79	(1)	٦
<u>L</u>	-	260	26.46	3.38	١.	1	18,000	164	0.78	(1)	
F36-17 90	006	260	28.09	1.46	13.2		32,800	164	08*0	(1)	
Avg.	-		25.98	1.84	69'6	! !	36,200	164	0.81		7
Std.De			1.47	0.86	2.82	1	13,200		0.03		Ī
F35-10 90	006	72					· ·	1904	1.27	(2)	
<u> </u>	906	72	33.82	2.31	8.92		37,000	1904	• 1	(2)	i
-	00	72	33.06	1.75	33.06		21,000	1904	• !	(2)	1
	006	72	29.69	1.35	9.41	1 .	54,300	1904	1.12	(2)	
<b> </b>			32.19	1.80	17.13	ì	.37,400		- 1		1
Std.Der			2.19	0.48	13.80	ii 22	002'91		0.10		П
											T
F35-12 90	006	260	23.12	1.38	14.81		34,300	1904	1.34	(2)	-1
ļ	-	260		2.23	10.87	1 5 2	13,000	1904	1.33	(2)	٦
L_	$\vdash$	260	22.71	1.45	9.19		44,500	1904	1.35	(2)	٦
F36-20 90	006	260	24.69	1.46	10.61	1 1	43,600	1904	1.32	(2)	1
Avg.			24.11	1.63	11.52		006'88		1.34		T
Std.Dev			1.48	0.40	2.24	2 0 0	14,600		0.02		T
											T
										And the second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second s	٦
(1)	50%	saturation	ation	(2) 1	100% saturation	tton					

Test:	Compression	ı	After En	nvi ronmental	Action	40UYL 8	4000 S	a p	Material : s	STC/5506
	•	- 1		121	46 990	- 1	, E	Pyrocent	1	
ţ	1	Test	1111	Mod.	מרדבים מר	£	0.000	o the Care	TC LOST	
No.	orien.	(°F)	(ksi)	(10°psi)	(ksi)		(nik/ain)	(hrs)	(8)	Remarks
542-2	006	72	30.41	4.59	4.34		32,100	162.5	0.83	(1)
342-12	006	72	31.44	3.14	7.85		33,000	162.5	0.64	(1)
542-22	006	7.2	29.88	5.25	18.29		7,100	162.5	0.79	(1), (3)
542-38	006	7.2	28.99		4.07	1 1	31,400	162.5	0.78	$\langle 1 \rangle$
542-54	06	7.2	26.90	3.82	3.61		5,700	162.5	0.76	(1), (3)
Avg.			29.52	4.19	7.63	1	32,200		0.76	excludes G42-22 &
Std.Dev			1.71	0.79	6.19	1 1	800		0.07	G42-54
642-3	006	260	19.77	3.14	5.50	1	5,300	162.5	0.78	(1), (3)
642-5	006	260	17.52	3.37	7.44	1	5,000	162.5	0.80	(1),(3)
642-8	006	260	18.45	2.04	6.53	1. 1.	8,000	162.5	0.75	(1), (3)
G42-13	06	260	19.29	2.63	5.19		7,400	162.5	0.79	(1),(3)
642-28	006	260	19.12	3.87	3.75	1	27,400	162.5	0.82	(1), (3)
Avg.			18.83	3.01	5.68		10,620		0.79	
Std.Dev			0.87	0.70	1.40	1 1	9,470		0.03	
642-4	906	7.2	25.71	2.33	11.22	] ]	17,900	1,752	- I	(2)
G42-16	<b>0</b> 06	72	24.69	2.72	8.15		18,200	1,752	1.41	(2)
G42-20	006	7.2	24.05	2.51	11.42		000'61	1,752	1.22	(2)
542-49	900	72	23.77	3.90	5.33		32,100	1,752	1.30	(2)
642-50	006	72	24.09	2.79	15.39	1 1	15,200	1,752	1.31	(2)
Avg.			24.46	2.85	10.30	1 1 1	20,480		1.31	
Std.Der			0.77	0.61	3.79	1 1	6,650		0.08	
G42-9	006	260	18.96	3.18	9.73	1 1	14,700	1,752	1:31	(2)
642-23	006	260	16.46	2.90	11.59		5.970	1.752	1.32	(2)
542-24	906	260	17.59	2.81	8.78	-	21,600	1,752	1.31	(2)
642-30	006	260	19.98	4.70	15.45		3,470	1,752	1.29	(2),(3)
G42-43	006	260	15.58	3,03	9.41		10,000	1,752	1.32	(2)
Avg.			17.71	3.32	10.99	-	11,150		1.31	
Std.Dev			1,79	0.78	2.70				0.01	
717 56.9	4 2 2	4.50	1001				,			

with the second of the second

(1) 50% saturation (2) 10

(3) Evidence of buckling

(2) 100% saturation (3)

Test:	Compression	l .	After Env		tal Aging	@ 160°F	, & 1008	к.н. М	,	HYE 2034D
Snar	Fiber	Test		Init. Mod.	Stress at	Pois.	Ult. Strain	Exposure Time	Weight	
No.		(°F)	(ksi)	(10 ⁶ psi)	(ksi)	Ratio	(ni/lin)	(hrs)	(8)	Remarks
H29-12	•06	72	12.00	3.02	3,35		13200	144.5	0.75	(1)
H29-33	°06	72	14.50	1.91	1.89		19500	144.5	0.78	(1)
H30-4	<b>0</b> 06	72	17.59	1.26	3.51		30700	144.5	0.73	(1)
H30-18	•06	72	12.39	1.47	2.58	1	18500	144.5	0.70	(1)
Avg.			14.12	1.92	2.83	-	20480		0.74	
Std.Dev			2.56	0.79	0.75		7360		0.03	
H29-14	°06	260	11.26	1.07	2.47		17500	144.5	0.76	(1)
H29-26	°06	260	12.80	2.00	2.38		22000	144.5	0.79	(1)
H29-18	06،	260	15.62	1.39	2.23	1	17700	144.5	0.79	(1)
H30-10	906	260	13.56	1.08	2.87		23500	144.5	0.75	(1)
H30-15	•06	260	13.70	1.38	1		11750	144.5	0.73	(1)
Avg.			13,39	1.39	2.49		18490.		0.76	
Std.Dev			1.58	0.38	0.27		4600		0.03	
H29-3	90.	72	14.73	1.18	6.25	1	14600	1706.25	1.29	(2)
H25-8	06ء	72	14.57	68.0	6.79		19200	1706.25	1.32	(2)
H29-27	•06	72	13.75	1.17	6.42		12300	2182.75	1.32	(2)
H29-30	9 ) 6	72	13.55	96.0	3.53		13800	2182.75	1.37	(2)
H30-8	904	72	19.34	1.07	4.92		16000	2182.75	1.35	(2)
Avg.			15.19	1.05	5.58	E 9 -	15180		1.33	
Std.Dev			2.38	0.13	1,35	-	2620		0.03	
H29-1	•06	260	13.33	1.22	2.10		19500	2182,75	1.25	(2)
H29-4	06	260	-	1.04	2.09	1		2182.75	1.57	(2),(3)
H30-5	<b>0</b> 06	260	14.15	96.0	3.33	1	25900	2182.75	1.36	(2)
H30-11	.06	260	17.05	1.27	3.76	4	13400	2182.75	1.32	(2)
H30-13	30.	260	19.63	98.0	÷		18300	2182,75	1.39	(2)
Avg.			16.04	1.07	2.82		19280		1.38	
Std.Dev			2.88	0.17	98.0		5140	***************************************	0.12	. Allen en en en en en en en en en en en en e
;						167				

(1) 50% saturation

(2) 100% saturation

(3) Damaged before test

Test:	Compression	,	After En	vironmental	tal Aging	@ 160°F	8 00T 3 3	R.H.	Material:	T300/V378A
000	1 2 2 2	Test	ult.	Init.	Stress at	0040	Ult.	Exposure	Weight	
No.	orien.	(°F)	(ksi)	(10 ⁶ psi)		Ratio	Jun/in)	(hrs)	(8)	Remarks
142-21	<b>.</b> 06	72°	26.99	1.96	1.53	1	25,500	17.5	0.73	(1)
142-29	906	72	25.73	1.79	1.82		36,300	17.5	0.64	(1)
142-43	900	72	25.35	2.56	1.98	-1 00-00	43,800	17.5	0.64	(1)
142-50	900	72	21.77	1.94	1.77		30,600	17.5	0.70	(1)
142-74	•06	72	21.17	1.54	1.61	-	22,800	17.5	0.72	(1)
Avg.			24.20	1.96	1.74		31,800		69.0	
Std.Dey			2.57	0.36	0.18		8,460		0.04	
I42-5	<b>0</b> 06	350	20.12	1.95	1.29	1	11,700	17.5	0.70	(1),(3)
142-34	906	350	20.41	2.13	2.43	1	29,500	17.5	0.76	(1)
142-45	90.	350	17.36	1.42	1.10	-	29,700	17.5	0.72	(1)
142-51	906	350	16.99	1.21	5.22		71,800	17.5	0.71	(1), (3)
142-58	900	350	16.77	1.29	1.76		13,800	17.5	0.67	(1),(3)
Avg.			18.33	1.60	2.36		*600*		0.71	*excludes I42-5,
Std.Dev			1.78	0.41	1.68				0.03	142-51, 142-58
142-7	•06	72	24.88	2.76	2.72		006'11	2,471	1.33	(2),(3)
142-11	<b>₽</b> 06	72	24.52	2.47	5.05		30,900	2,471	1.33	(2)
142-23	906	72	25.97	1.71	5,09		32,500	2,471	1.36	(2)
142-27	•06	72	24.92	2,86	4.52		11,500	2,471	1.33	(2),(3)
142-31	<b>0</b> 06	72	26.34	2.45	4.28		12,900	2,471	1.33	(2),(3)
Avg.			25.33	2.45	4.33		31,700*		1.34	*excludes 142-7,
Std.Dev			0.79	0.45	0.97				0.01	142-27, 142-31
I42-35	°06	350	16.93	3.55	2.60		26,200	2,471	1.38	(2)
142-39	90ء	350	17.07	1.13	4.22		12,500	2,471	1.34	(2)
142-46	90°	350	21.97	3,68	2.21		33,400	2,471	1.37	(2)
142-53	906	350	20.36	2.60	3.43		11,500	2,471	1.36	(2),(3)
142-55	•06	350	20.53	1.89	3.54		11,800	2,471	1.35	(2), (3)
Avg.			19.37	2.57	3.20		25,030*		1.36	*excludes 142-53,
Std.Dev.			2.25	1.09	0.80		*010'6		0.02	142-55
(1) 50	50% saturation	tion	(2) 100%	% saturation	ion	(3) Evic	Evidence of buckling	uckling		

Test:	Compression	ì	After Env	vironmental	Aging	@ 160°F	, & 100\$	К.н.	Material:	нуе 10763
		Test	UIt.	Init.	Stress at		Ult.	Exposure	Welght	
Spec.	Fiber Orien.	Temp.	Strgth.	Mod. (10°psi)	Prop.Lim. (ksi)	Pois. Ratio	Strain Quin/in	Time (hrs)	Gain (8)	Remarks
331-13	906	72	28.30	2.06	5.36		28200	161	0.74	(1)
331-37	"06	72	24.25	2,42	4.81		24300	161	08.0	(1)
J31-41	06،	72	23.98	2.11	1.81		21700	161	0,75	(1)
J31-54	•06	72	25.45	2.27	3.02	1	11600	161	0.68	(1)
Avq.			25.50	2.22	3.75		21450		0.74	
Std.Dev			1.98	.16	1.63	an au an	0602		0.05	
		- commence comment					0004		0,0	
J31-3	900	260	21.28	2.00	3,69		15900	TOT	60.0	(T)
J31-11	900	260	19.19	2.04	2.81	# · · · ·	11300	161	0.78	(1)
J31-30	•06	260	24,33	1.43	6.16	ŀ	34700	161	0.68	(1)
,731-47	•06	260	20.17	2.44	2.91		12800	161	0,76	(1)
J31-51	06	260	19.24	1.62	4.39		0056	161	0.78	(1), (3)
Avg.			20.84	1.91	3.99	1	*0898T		0.74	*excludes J31-51
Std.Dev			2.13	0.39	1.37	37 37 48	10850*		0.05	
J31-1	<b>0</b> 06	72	21.8	1.86	13.7	AND 400 AND	9400	1,242	1.04	(2),(3)
J31-14	06،	72	24.2	1.77	12.5		25400	1,242	1.08	(2)
<b>J31-16</b>	<b>.</b> 06	72	26.4	1.40	6.9	A. 40. 40	26600	1,242	1.09	(2)
J31-24	06،	72	25.9	1.71	6.6	1	14300	1,242	1.07	(2),(3)
J31-40	<b>0</b> 06	72	29.3	1.43	8.9	49 000 000	43100	1,242	0.97	(2)
Avg.			25.5	1,63	10.4		31700*		1.05	*excludes J31-1,
Std.Dev.			2.8	0.21	2.7	10. and 80	<b>*</b> 0686		0.05	J31-24
331-8	•06	260	17.9	2.38	10.0	1 1 1	11600	1.242	1,09	(3)
J31-32	06	260	18.9	1.76	5.9	P1 00 00	32000	1,242	1,08	(2)
J31-44	06	260	16.8	1.69	5.8		20800	1,242	1.07	(2)
J31-52	06	260	20.3	1.15	4.6		17900	1,242	1.12	(2)
J31-56	06	260	23.4	1.22	7.1		28800	1,242	1.08	(2)
Avg.			19.5	1.64	6.7	<u>.</u>	22220		1.09	
Std.Dev.			2.6	0.50	2.1		8250		0.02	

(1) 50% saturation (2) 100% saturation

n (3) Evidence of buckling

Test:	Compression After	on After	Envir	onmental	Aging @ 10	160°F &	100% R.H		Material: 6-]	G-160/6535÷1
Spec.		Test Temp.	Ult. Strgth.		Stress at Prop. Lim.	Pois.	Ult. Strain	Exposure Time	Weight Gain	
NO.	Orien.	(°F)	_	(100psi)	) (ksi)	Ratio	((l <b>in</b> /ln)	(hrs)	(8)	Remarks
K19-8	°06	7.2	30.65	52.T	7.82	me and the	16,900	166.5	69.0	Evidence of buckling
K19-32	900	7.2	25.85	1.78	14.63	1 -	26,000	166.5	0,61	50% saturation
K44-6	°06	22	29.98		3,35			166.5	0.62	
K44-10	.06	72	28.51	1.79			29,000	166.5	0.61	50% gaturation
K44-29		72	28.89	1.90	5.50		20,000	166.5	0,65	50% saturation
Avg.			28.73	1.81	9.07		22,980		0.62	
Std.Dev			1.84	90.0	5.07		5,510		0.02	
K19~38	÷06	260	18.37	1.59	7.17		7,960	166.5	0.61	Evidence ofbuckline
K44~5	°06	260	21.30	1.43	8.48	*	36,000	166.5	0.62	50% saturation
K44-7	°06	760		1.45	4.39	e ; ene	35,000	166.5	0.64	50% saturation
K44-16	, 06 ,	260	22.33	1.25	6.80		36,000	166.5	0.65	50% saturation
K44-26	90°	260	20.12	1.31	6.10		31,000	166.5	0,63	50% saturation
Avg.			20.58	1.41	6.59	1	29,180		0,63	
Std.Dev			1.48	0,13	1.50	ar con er	12,070		0.02	
K19-31	•06	72	28.80	1.70	15.60	any man and	19,450	1532	1.22	100% saturation
K19-39	90°	72	23.28	1.43	13,20		30,500	1532	1.21	100% saturation
K44-14	90,	72	29.04	1.71	11.92		29,500	1532	1.23	100% saturation
K44-15	90°	72	28.27	1.64	7.12		27,100	1532	1.22	100% saturation
K44-20	906	72								failed in handling
Avg.			27.35	1.62	11.96		26,640		1.22	
Std.Dev			2.73	0.13	3.87	e	5,000		0.01	
K19-7	°06	260	18.74	1,63	4.20		12,700	3621	1.27	Evidence of buckling
K13-29	906	260	16.90	1.63	2.97		28,000	3621	1.24	100% saturation
K19-33	900	260	16.17	1.46	3.68	1 4 4	26,000	3621	1.28	100% saturation
K19-44	•06	260	16.49	1.66	2.48		31,000	3621	1.28	100% saturation
844-9	°06	260	18.43	1.64	3.26		36,000	3621	1.28	100% saturation
avg.			17.34	1.61	3.32		26,740		1.27	
Std.Dev			1.16	80.0	99.0		8,710		0.02	A CONTRACTOR OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY O

## APPENDIX Q HUMIDITY AGED INTERLAMINAR SHEAR DATA

All of the interlaminar shear data generated during this program on specimens which had been humidity aged at 160°F (71°C) and 100% R.H. are presented in this section. These data are summarized in Sections 4.1 through 4.6.

Agi		Short-Beam) °F and 100%	R.H.		
Materials:	T300/AFR80	0	L/D Rat	io: 4/	<u> </u>
Specimen Number	Test Temp. (°F)	Ultimate Strength (ksi)	Exposure Time (Hrs)	Weight Gain (%)	Remarks
F21-4	72	15.88	27	0.63	50% saturation
F21-5	72	16.66	2.7	0.62	50% saturation
F21-13	72	16.62	27	0.62	50% saturation
F21-19	72	15.35	27	0.80	50% saturation
F21-21	72	14.73	27	0.54	50% saturation
F21-25	72	15.45	27	0.83	50% saturation
F21-32	72	14.54	27	0.42	50% saturation
F21-34	72	16.27	27	0.65	50% saturation
F21-37	72	16.31	27	0.92	50% saturation
F21-38	72	14.90	27	0.63	50% saturation
Avg.		15.64		0.67	
Std. Dev.		0.79		0.15	
F21-47	260	10.60	27	0.52	50% saturation
F21-50	260	11.19	27	0.77	50% saturation
F21-62	260	10.03	27	1.06	50% saturation
F21-63	260	10,25	27	0.82	50% saturation
F21-70	260	10.68	27	0.72	50% saturation
Avg.		10.56		0.78	
Std. Dev.		0.43		0.19	
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Test: Interlaminar (Short-Beam) Shear After Environmental Aging at 160°F and 100% R.H. Materials: L/D Ratio: 4/1 T300/AFR300 Exposure Weight Test Ultimate Time Specimen Gain Temp. Strength Number (°F) (ksi) (Hrs) (%) Remarks F21-1 72 14.12 1286 1.01 saturation F21-8 72 14.75 1236 1.17 saturation F21-17 72 13.65 1286 1.19 saturation F21-22 72 14.57 1206 1.33 saturation F21-29 72 13.34 1236 1.37 saturation F21-31 72 13.53 1286 1.55 saturation F21-40 72 14.14 1286 1.02 saturation F21-42 72 13.37 1286 1.33 saturation F21-52 72 12.85 1236 1.35 saturation F21-59 72 12.92 1286 1.26 saturation 13.78 1.26 Avg. Std. Dev. 0.64 0.17 F21-2 260 7.41 1286 1.39 saturation F21-28 260 7.52 1286 1.31 saturation F21-30 260 1286 7.33 1.36 saturation 1286 F21-39 260 7.43 1.96 saturation F21-60 260 7.63 1236 1.19 saturation 1.24 Avg. 7.47 Std. Dev. 0.10 0.18

22. SV

Interlaminar (Short-Beam) Shear After Environmental Test: Aging at 160°P and 100% R.H. Materials: SiC/5506 L/D Ratio: Exposure Weight Test Ultimate Specimen Temp. Time Strength Gain (Hrs) Number (°F) (ksi) (8) Remarks G38-7 72 11.09 384 0.65 50% saturated G38-15 72 11.07 384 0.45 50% saturated G38-19 72 11.53 0.72 384 50% saturated G38-27 72 11.87 384 0.49 50% saturated G38-37 72 12.06 384 0.64 50% saturated G38-45 72 11.59 384 0.69 50% saturated 11.77 G38-49 72 384 0.71 50% saturated G38-52 72 11.49 384 0.66 50% saturated G38-55 72 11.76 384 0.65 50% saturated G38-64 72 11.85 384 0.66 50% saturated 11.61 Avg. 0.63 0.33 Std. Dev. 0.09 G38-10 260 6.30 384 0.51 50% saturated G38-21 260 6.98 384 0.90 50% saturated G38-43 260 7.00 384 50% saturated 0.63 G38-59 260 6.67 384 0.67 50% saturated G38-66 260 6.98 384 0.63 50% saturated Avg. 6.79 0.67 0.30 0.14 Std. Dev.

Agi	rlaminar ( ing at 160	Short-Beam) °F and 100%	R.H.		vironmental
Materials:	Sic/5506		L/D Rat		
Specimen Number	Test Temp. (°F)	Ultimate Strength (ksi)	Exposure Time (Hrs)	Weight Gain (%)	Remarks
G38-3	72	10.85	240	1.06	saturation
G38-14	72	10.74	240	0.92	saturation
G38-22	72	12.46	240	1.85	saturation
G38-26	72	12.56	240	1.49	saturation
G38-32	72	12.57	240	0.88	saturation
G38-34	72	12.57	240	0.90	saturation
G38-35	72	12.57	240	1.06	saturation
G38-38	72	12.59	240	0.87	saturation
G38-46	72	12.08	240	0.93	saturation
G38-50	72	12.16	240	0.96	saturation
G38-65	72	11.57	240	0.84	saturation
Avg.		12.06		1.07	
Std. Dev.		0.70		0.31	
G38-18	260	7.25	335	1.02	saturation
G38-29	260	7 14	335	0.96	saturation
G38-42	260	7.04	335	1.47	saturation
G38-53	260	7.01	335	1.07	saturation
G38-62	260	7.31	335	0.93	saturation
Avg.		7.15		1.09	
Std. Dev.		0.13		0.21	
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Materials:	HYE 2034D	°F and 100%	L/D Rat	io: 4/	<u>′1</u>
Specimen Number	Test Temp. (°F)	Ultimate Strength (ksi)	Exposure Time (Hrs)	Weight Gain (%)	Remarks
н31-9	72	7.36	167	0.77	50% saturated
H31-13	72	7.64	167	0.65	50% saturated
H31-23	72	7.24	167	0.72	50% saturated
H31-27	72	6.89	167	0.84	50% saturated
н31-32	72	6.44	167	0.67	50% saturated
H31~52	72	6.59	167	0.73	50% saturated
H31-60	72	7.13	167	0.70	50% saturated
H31-61	72	6.67	167	0.79	50% saturated
H31-43	72	7.32	167	0.68	50% saturated
H31-33	72	6.91	167	0.60	50% saturated
Avg.		7.02		0.72	
Std. Dev.		0.38		0.07	
н31-4	260	5.87	167	0.72	50% saturated
H31-11	260	5.33	167	0.55	50% saturated
H31-15	260	5.50	167	0.60	50% saturated
H31-62	260	5.46	167	0.92	50% saturated
н31-45	260	5.61	167	0.76	50% saturated
Avg.		5.50		0.71	
Std. Dev.		.20		0.15	
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Test: Interlaminar (Short-Beam) Shear After Environmental Aging at 160°F and 100% R.H. Materials: L/D Ratio: 4/1 HYE 2034D Test Exposure Weight Ultimate Time Specimen Temp. Strength Gain Number (°F) (ksi) (Hrs) (8) Remarks H31-6 72 7.40 862 1.45 saturated H31-14 72 7.29 862 1.15 saturated H31-18 72 1.26 7.35 862 saturated H31-25 72 7.68 862 1.66 saturated H31-26 72 6.99 862 1.51 saturated H31-29 6.39 72 862 1.63 saturated H31-31 72 7.35 362 1.38 saturated H31-38 72 7.16 862 1.33 saturated H31-39 72 7.08 1.36 862 saturated H31-50 72 7.43 862 1.19 saturated 7.21 Avg. 1.39 Std. Dev. 0.35 0.17 H31-37 260 4.32 862 1.26 saturated H31-58 260 4.14 862 1.33 saturated H31-65 260 4.16 862 1.30 saturated H31-63 260 3.69 862 1.67 saturated H31-67 260 4.14 362 1.31 saturated Avg. 4.09 1.37 Std. Dev. .24 0.17

	•	Short-Beam) °F and 100%		ter Env	vironmental
Materials:	T300/ <b>W</b> 378A		L/D Rat	io: 4/	1
Specimen Number	Test Temp, (°F)	Ultimate Strength (ksi)	Exposure Time (Hrs)	Weight Gain (%)	Remarks
I 15-5	720	14.40	<481	0.79	50% saturation
I 15-11	720	13.45	<481	0.86	50% saturation
I 15-15	720	13.67	<481	0.85	50% saturation
I 15-19	72°	14.16	<481	0.81	50% saturation
I 15-23	720	13.86	<481	0.70	50% saturation
I 15-30	72°	14.03	<481	0.74	50% saturation
I 15-44	720	14.33	<481	0.46	50% saturation
I 15-46	720	13.96	<481	0.76	50% saturation
I 15-50	720	14.19	<481	0.65	50% saturation
I 15-52	72 ⁰	13.88	<481	0.81	50% saturation
Avg.		13.99		0.74	
Std. Dev.		0.29		0.12	
I 15-54	3500	8.71	<481	0.65	50% saturation
I 15-57	3500	8,69	<481	0.72	50% saturation
I 15-60	350°	7.84	<481	0.74	50% saturation
I 15-72	350°	9.70	<48 ¹	0.77	50% saturation
I 15-73	3500	9.59	< 481	0.74	50% saturation
Avg.		8.91		0.72	
Std. Dev.		0.76		0.05	
¹ Specimens	gained we	ght so rapi	dly that	they we	re already
		eighing (48			re dried in
	1			6 hr. t	o reach weight
gain indic					

Interlaminar (Short-Beam) Shear After Environmental Test: Aging at 160°F and 100% R.H. Materials: T300/V378A L/D Ratio: 4/1 Test Ultimate Exposure Weight Specimen Time Temp. Strength Gain Number (°F) (Hrs) (ksi) (%) Remarks 720 I 15-3 14.49 138 1.17 saturated 72° I 15-7 13.60 1.22 138 saturated 720 I 15-22 14.47 138 1.29 saturated I 15-31 720 14.53 138 0.94 saturated 720 I 15-33 14.24 138 1.32 saturated 720 I 15-35 14.47 138 1.27 saturated 72° I 15-36 14.61 138 1.23 saturated 72° I 15-40 13.99 138 1.17 saturated I 15-42 720 15.04 138 1.27 saturated 72° I 15-48 14.18 138 1.12 saturated Avg. 14.36 1.20 Std. Dev. 0.39 0.11 350° I 15-51 8.14 130 1.15 saturated 350° I 15-53 7.32 133 1.28 saturated 350° I 15-55 7.55 138 1.11 saturated 350° I 15-58 7.04 138 1.22 saturated 350° I 15-77 7.39 138 1.44 saturated 7.49 Avg. 1.24 Std. Dev. 0.41 0.13

Interlaminar (Short-Beam) Shear After Environmental Test: Aging at 160°F and 100% R.H. Materials: L/D Ratio: 4/1 HvE 1076J Test Weight Ultimate Exposure Time Specimen Temp. Strength Gain (°F) Number (Rrs) (8) (ksi) Remarks J26-20 72 9.62 188 0.38 50% saturated J26-25 72 11.27 0.54 50% saturated 188 J26-28 72 10.58 188 50% saturated 0.73 J26-58 72 12.87 188 0.30 50% saturated J26-68 72 15.17 50% saturated 188 0.77 J26-71 72 13.41 188 0.51 50% saturated J26-79 72 11.17 188 0.53 50% saturated J26-36 72 12.61 188 0.51 50% saturated 72 J26-50 10.14 188 0.42 50% saturated J26-62 72 11.91 0.82 188 50% saturated Avg. 11.88 0.55 0.17 Std. Dev. 1.68 J26-31 260 6.45 188 0.65 50% saturated 7.06 J26-43 260 188 0.98 50% saturated J26-45 260 9.43 188 0.34 50% saturated J26-55 260 9.92 188 0.37 50% saturated J26-75 50% saturated 260 9.34 188 0.84 8.44 0.64 Avg. 1.57 0.28 Std. Dev.

Agi	ing at 160	Short-Beam) °F and 100%	R.H.		
Materials:	НуЕ 1076Ј		L/D Rat	io: 4/	<u>/1                                    </u>
Specimen Number	Test Temp. (°F)	Ultimate Strength (ksi)	Exposure Time (Hrs)	Weight Gain (%)	Remarks
J26-11	72	13.41	1,675	0.98	saturated
J26-24	72	11.42	1,675	1.02	saturated
J26-32	72	9.42	1,675	1.16	saturated
J26-42	72	10.39	1,675	0.91	saturated
J26-47	72	12.59	1,675	1.03	saturated
J26-60	72	11.67	1,675	0.99	saturated
J26-65	72	11.02	1,675	1.17	saturated
J26-72	72	14.04	1,675	1.14	saturated
J26-82	72	14.11	1,675	1.28	saturated
J26-87	72	11.70	1,675	1.45	saturated
Avg.		11.98		1.11	
Std. Dev.		1.55		0.16	
J26-15	260	6.44	1,675	1.19	saturated
J26-39	260	6.64	1.675	1.15	saturated
J26-54	260	6.62	1,675	1.24	saturated
J26-63	260	6.72	1,675	1.17	saturated
J26-76	260	7.78	1,675	1.28	saturated
Avg.		6.84	ļ	1.21	
Std. Dev.		0.54		0.05	
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Agi	ing at 160	°F and 100%	R.H.		vironmental
Materials:	G-160/6535	-1	L/D Rat		/1
Specimen Number	Test Temp. (°F)	Ultimate Strength (psi)	Exposure Time (Hrs)	Weight Gain (%)	Remarks
K18-7	72	13.56	91	0.50	50% saturated
K18-9	72	14.05	91	0.60	50% saturated
K18-11	72	14.65	91	0.68	50% saturated
K18-19	72	14.46	91	0.60	50% saturated
K18-33	72	13.79	91	0.47	50% saturated
K18-40	72	13.97	91	0.42	50% saturate 1
K18-50	72	13.70	91	0.48	50% saturated
K18-54	72	15.08	91	0.54	50% saturated
K18-59	72	14.82	91	0.64	50% saturated
K18-61	72	14.56	91	0.60	50% saturated
Avg.		14.26		0.55	
Std. Dev.		0.52		0.08	
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K18-21	260	8.40	91	0.63	50% saturated
K18-36	260	8.97	91	0.55	50% saturated
K18-42	260	9.86	91	0.56	50% saturated
K18-56	260	9.44	91	0.44	50% saturated
K18-60	260	9.76	91	0.59	50% saturated
Avg.		9.28		0.56	
Std. Dev.		0.60		0.07	
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Test: Interlaminar (Short-Beam) Shear After Environmental Aging at 160°F and 100% R.H.					
Materials: G-160/6535-1 L/D Ratio: 4/1					
Specimen Number	Test Temp. (°F)	Ultimate Strength (psi)	Exposure Time (Hrs)	Weight Gain (%)	Remarks
K18-3	72	12.00	1530	1.20	Saturated
K18-5	72	10.99	1530	1.12	Saturated
K18-13	72	11.83	1530	1.17	Saturated
K18-17	72	12.56	1530	0.99	Saturated
K18-24	72	12.77	1530	1.38	Saturated
K18-27	72	12.62	1530	0.84	Saturated
K18-30	72	11.46	1530	1.15	Saturated
K18-43	72	12-81	1530	1.20	Saturated
K18-53	72	12.96	1530	1.24	Saturated
K18-58	72	13.28	1530	1.25	Saturated
Avg.		12.33		1.15	
Std. Dev.		0.73		0.15	
K18-4	250	6.28	1530	1.05	Saturated
K18-8	260	6.50	1530	1.23	Saturated
K18-15	260	6.57	1530	1.03	Saturated
K18-29	260	6.57	1530	1.26	Saturated
K18-39	260	6.62	1530	1.65	Saturated
Avg.		6.51		1.13	
Std. Dev.		0.14		0.11	
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